Master's Thesis of Sooyoung Choi

Association between gender equality and gender difference in adult mortality and morbidity in low- and middle-income countries

-A panel data analysis-

개발도상국의 젠더 평등과 젠더 간 성인 사망 및 질병 차이의 관계: 패널 데이터 분석

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Abstract

Association between gender equality and gender difference in adult mortality and morbidity in low- and middle-income countries: A panel data analysis

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Reducing the global health gap has always been one of global health practitioners' concerns, and gender inequality is one the universal factors that attribute to global health gap. Gender equality is defined as "the absence of discrimination on the basis of a person's sex in opportunities, the allocation of resources and benefits, or access to services" (WHO gender policy, 2002). Gender inequality damages the health of both women and men worldwide, and the current

gender gap in health outcomes needs to be analyzed in order to plan effective actions to tackle gender inequality in health. However, researches that examine what factors have impacts on the gender gap in health outcomes are not abundant; especially studies on relationship between gender equality and gender gap in health of adults in low- and middle-income countries(LMICs) are scarce. this study aims to investigate the association between gender equality and gender gap in adult mortality and morbidity (disease burden of those aged 15-64 years) in LMICs in the years between 2006 and 2016. The concepts of shortfall equality and attainment equality, which were introduced by Anand and Sen in 1995, were taken into account when interpreting study results.

A panel analysis was conducted to investigate both the cross-sectional and longitudinal association between gender equality and gender difference in adult mortality and morbidity in LMICs. To assess gender inequality, the GGI produced by the World Economic Forum from 2006 to 2016 was used. Adult mortality rate and life expectancy was chosen among many related measures of mortality. YLD (Years Lost due to Disability) of disability-adjusted life-years (DALY) produced from the Institute for Health Metrics and Evaluation was used to measure overall burden of all causes, HIV/AIDS, and diabetes. This study used World Bank Atlas method when grouping low-income-countries (LICs), lower- and middle-income countries (LMICs), and upper- and middle- income countries (UMICs). Data of LICs and LMICs were merged in order to obtain a large enough sample to generate reliable results.

The gap between female adult mortality and male adult mortality (per person) shows a statistically significant negative association

with the GGI in LICs and LMICs, but not with the GGI in UMICs; the gap between female life expectancy and male life expectancy shows a statistically significant positive association with the GGI in LICs and LMICs, but not with the GGI in UMICs; the gap between female overall YLD and male overall YLD for those between the ages of 50 and 64 years (per person) does not show any statistically significant association with the GGI in LICs and LMICs and UMICs; the gap between female YLD of HIV/AIDS and male YLD of HIV/AIDS for those between the ages of 15 and 49 years (per person) shows a statistically significant positive association with the GGI in LICs and LMICs; the gap between female YLD of diabetes and male YLD of diabetes for those between the ages of 15 and 49 years (per person) shows a statistically significant negative association with the GGI in UMICs; and the gap between female YLD of diabetes and male YLD of diabetes for those between the ages of 49 and 64 years (per person) shows a statistically significant positive association with the GGI in UMICs.

Concerning LICs and LMICs, these results show the importance of expanding the budget of CHE to combat HIV/AIDS and diabetes. It was found that CHE and the gender gap in YLD of HIV/AIDS for those aged 15–64 years was negatively associated; additionally, CHE and the gender gap in YLD of diabetes for those aged 15–64 years was negatively associated.

In UMICs, gender sensitive policies are needed to decrease the disease burden of diabetes. A 0.1 increase in the GGI results in a 0.00094 decrease in the gender gap of YLD of diabetes in population of those aged 15–49 years. That is, when a country becomes more gender equal, the gender gap in diabetes will likely decrease.

Furthermore, it appears beneficial for UMICs to increase the magnitude of CHE to decrease the burden of HIV/AIDS, since it was found that a one unit increase in CHE results in a decrease in the gender gap of YLD of HIV/AIDS in population of those aged 15–49 years by 0.000001. The GNI did not show any statistically significant associations with the gender gap in health in UMICs.

There are four main findings from this study. First, panel analyses revealed that the magnitude and direction of the gender gap in health vary greatly by context, which can differ greatly based on the type of disease, type of health outcome, income level of the country, age of patients, targeted region and culture, etc. Therefore, the results do not suggest one specific approach to the gender gap in adult morbidity is desirable. Different strategies are needed to close the overall gender gap in health, taking the complex nature of the specific gender gap into account.

Second, there appears to be no relationship between the signs of the coefficients of the GGI, GNI, and CHE in any way (Appendix 3). The fact that the GGI and GNI are not associated enables us to validate the main purpose of the GGI, which aims to merely measure the gender gap as opposed to "the actual levels of the available resources and opportunities in those countries" (World Economic Forum, 2015), as aforementioned.

Third, every independent variable used in the analyses can have statistically significant negative associations and statistically significant positive associations with the gender gap in health (Appendix 3). That is, we cannot determine whether an

independent variable will decrease the gender gap or increase the gender gap since it differs by the type of health outcome. These findings lead to the conclusion that understanding the gender context in each country is crucial and further research is needed to determine what causes different gender gap in health.

Lastly, regarding policy implication of this study, there is a need to pin down not only the gender gap, but also its direction. It is important to determine which gender suffers from more health disadvantages, as resources allocated for improving health are limited.

Policy makers should devise action plans and policies that use existing resources strategically, or gender sensitively in this case.

Keyword: gender equality, gender, gender gap in health, gender mainstreaming, adult mortality, adult morbidity

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Chapter 1. Introduction

1.1 Study Background and Literature Review

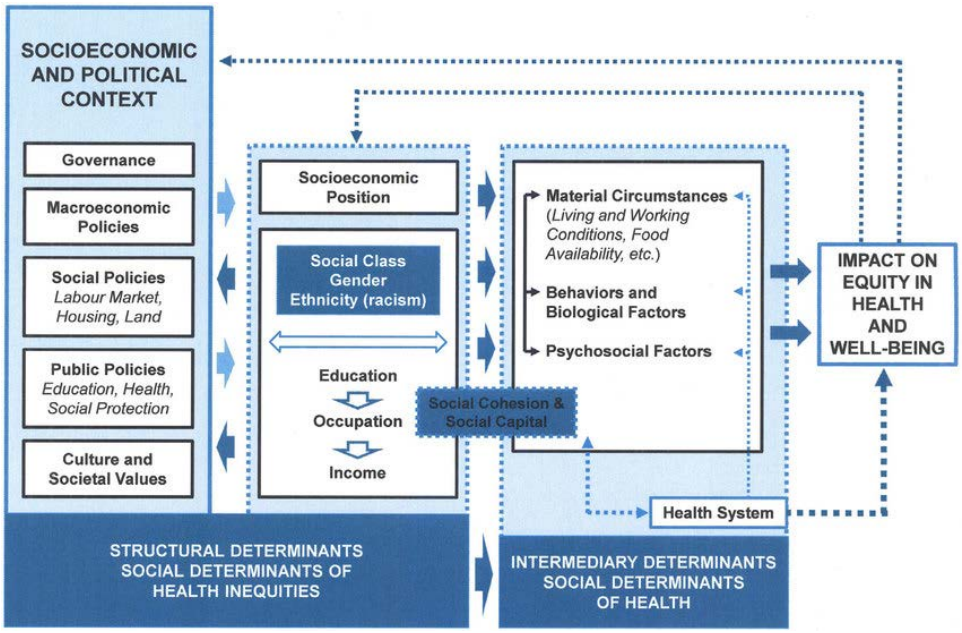
Reducing the global health gap has always been one of global health practitioners' concerns. "Since the middle of the 20th century, national governments and international organizations have committed to eliminating the gap between the most and least disadvantaged" (The Lance Global Health, 2016). Unfortunately, this gap remains wide open. Efforts to close this gap are needed for every human being to pursue "the right to the highest attainable standard of health" (WHO Constitution, 1946).

In its final report in 2008, the Commission on the Social Determinants of Health (CSDH) suggested three principles of action to improve health equity:

1. Improve daily living conditions
2. Tackle the inequitable distribution of power, money, and resources
3. Measure and understand the problem and assess the impact of action

(CSDH, 2008).

Regarding the third principle mentioned above, gender inequality is one of the universal inequities that must be measured and understood, since gender constitutes structural and social determinants of health.



[Figure 1] A conceptual framework of social determinants of health.

According to Johnson (2009), gender refers to roles each sex assumes within a specific group, setting, culture, or country, and to associated hierarchies, power relations, differential access to resources, and divisions of labor. According to Government of Canada (2017), sex refers to the biological, genetic and physiological processes that generally distinguish females from males. Although often categorized as binary for analysis, attributes of sex and gender are multidimensional, dynamic and interactive.

The WHO gender policy defines gender equality as “the absence of discrimination on the basis of a person's sex in opportunities, the allocation of resources and benefits, or access to services” (WHO gender policy, 2002). Gender inequality damages the health of both women and men worldwide. Gender-related power imbalances contribute to excess female mortality across the life cycle (USAID, 2018). Men often suffer from unhealthy behaviors and reduced

longevity, while being simultaneously endowed with benefits from resources, power, authority and control (Sen et al., 2007). According to Cochrane Musculoskeletal Group (2014), dynamics of gender may influence prevention, diagnosis, treatment and outcome of disease even when the disease is sex-specific (e.g., prostate cancer, ovarian cancer).

The current gender gap in health outcomes needs to be analyzed in order to plan effective actions to tackle gender inequality in health. However, researches that examine what factors have impacts on the gender gap in health outcomes are not abundant.

Gender and sex have been known to have considerable influence on one's health status and there already exists a massive volume of studies that investigate gender difference in health outcome *per se*. A good example is a study by Crimmins (2018), which examined how biological and social characteristics of women and men had influences on gender differences in health outcomes.

Also, there are some researches that investigate how gender equality influences health outcomes, focusing on maternal mortality ratio (MMR), or child mortality. In a cross-national study that explored the correlation between the GGI and the maternal mortality ratio (MMR), the low and lower-middle-income countries showed lower scores on the GGI, as well as economic participation, educational attainment, and political empowerment sub-indices than the high-income group. It was also reported that when the proportion of skilled birth attendance and public share of health expenditure was controlled, the educational attainment sub-index

showed a significant negative correlation with the MMR in low and lower-middle-income countries (Choe, 2016).

On a cross-national study of 138 countries investigating the association between the Gender Inequality Index (GII) (2010) and child mortality rates, significant positive associations between gender inequality index and neonatal, infant, and under-five years old child mortality rates were found after adjusting for the effects of major economic and health service variables. The study also revealed that women in LMICs suffer significantly more gender inequality (Brinda, 2015).

There also exists a research that examines association between gender equality and gender gap in health, although targeting countries that are relatively well-off (Kolip, 2018). A recent cross-national study by Kolip investigated the association between gender inequality and gender gap in life expectancy (GGLE) at birth in the EU 28 Member States. Gender inequality was represented with GII (2015) and GGLE (2015) was calculated by subtracting the LE of men from that of women. It was found that gender inequality affects LE in women and men as well as the GGLE, and that "gender equality policies are still necessary and will have an effect on women's as well as men's health" (Kolip, 2018).

Another cross-national study of 28 European countries analyzed gender gaps in self-rated health (SRH) and limiting longstanding illness (LLI), using Gender Inequality Index (GII) and five rounds of the European Social Survey (ESS) data from 2002 to 2010. According to Dahlin (2013), women report distinctly worse health in many countries, especially in Eastern and Southern Europe, whereas

there are small or no differences in other countries. Also individual-level factors attribute more to the gender gaps than cross-national variation. "Against expectations, the remaining gaps are not systematically related to societal-level gender inequality in the multilevel analyses" (Dahlin, 2013).

There is a previous study that performed a cross-sectional analysis targeting all countries that have available data. Medalia (2011) examined the relationship between gender equality and the sex gap in mortality in 131 countries. A cross-sectional analysis was conducted using a modified version of the GGI, and it was found that the influence of gender equality is conditional on level of development. According to Medalia, gender equality is associated with divergence between female and male life expectancies in Less Developed Countries (LDCs), whereas it is associated with convergence in Highly Developed Countries (HDCs).

Ultimately it can be seen that there is very little research on relationship of the Gender Gap Index (the GGI) and gender difference in health in LMICs. In addition, regardless of the types of gender-related indices, previous researchers employed cross-sectional analysis, not conducting longitudinal analysis to examine dynamic association of gender equality and the gender gap in health.

It seems reasonable to question how gender equality affects the gender gap in health. The relationship between gender equality and the gender gap in health in LMIC adults should be examined. Before investigating the association between gender equality and the gender gap in health, one should be careful in selecting perspective when examining gender equality. Also, being gender equal can be

interpreted in different ways, depending on characteristics of the very health outcome that is being examined. Health outcomes can be divided into two parts: mortality (life expectancy) and morbidity.

There exist two different stances that can be considered when interpreting gender gap in health. Ananda and Sen (1995) discussed two different approaches regarding the gender gap in health: shortfall equality versus attainment equality.

The concept of shortfall equality is based on a premise that "what must be compared are the shortfalls of actual achievement from the respective maximal achievements of each group" (Anand & Sen, 1995). But this approach is ambiguous in some ways and has its limitations, since rich diversity found in the human race makes it impossible to set equal maximal levels for everyone to achieve. Also, it is difficult to assess achievement and judge equality of achievement. Hence, the methodology of the Human Development Report adapted this approach and performed a re-scaling in order to reflect the potentially higher longevity of women.

The concept of attainment equality is more concerned about "equal absolute levels of achievement (irrespective of what the maximal potentials are)" (Anand & Sen, 1995). As far back as ancient Greece, Aristotle stated in his work *Politics*, "For it is appropriate, if people are governed best that they should do best, in so far as their circumstances admit — unless something catastrophic happens."(Nussbaum, 1988).

Anand and Sen (1995) suggested that shortfall equality seems logically reasonable when dealing with mortality (LE). That is, they

argue that when there is less of a gender gap, there is less gender equality, based on concept of shortfall equality.

On the contrary, Kolip (2018) insisted the opposite, hypothesizing that the gender gap in life expectancy is smaller in countries with more gender equality. Also, Kolip mentions convergence of unhealthy behaviors that are influenced by social norms (which in turn impacts gender inequality) as one of the reasons of the convergence of female LE and male LE between 1990 and 2015 (increase of female LE by 4%, increase of male LE by 8%) in the Netherlands.

However, it should be noted that life expectancy of all genders has significantly increased (or adult mortality has significantly decreased) and that there is fairly small shortfall when comparing average life expectancy and "maximal achievements" of all genders. Also, Kolip's study targeted countries in the European Union. It does not seem appropriate to apply same logic to LMICs and expect that the more gender equal, the less the gender gap in LE. Hence, following the shortfall equality approach seems more appropriate

As for interpreting the gender gap in morbidity, the concept of "attainment equality" explained by Anand and Sen (1995) seems logically rational. Unlike life expectancy, the burden of a disease does not have an ideal value to be compared with, therefore the concept of shortfall equality cannot be applied to morbidity. As mentioned earlier, attainment equality focuses on achieving equally ideal absolute levels of health, regardless of its maximum potential.

1.2 Purpose of Research

Taking into account those concepts of equality mentioned earlier, this study aims to investigate the association between gender equality and gender gap in adult mortality and morbidity (disease burden of those aged 15-64 years) in LMICs by conducting panel analysis targeting LMIC in the years between 2006 and 2016.

Compared to cross-sectional analysis, panel data analysis can provide more accurate inference of model parameters, more control on the impact of omitted variables (Hsiao et al., 1995), and uncover dynamic relationships between dependent and independent variables over time (Hsiao, 2007).

1.3 Hypothesis

(1) The gap between female adult mortality and male adult mortality (per person) does not have a statistically significant association with the GGI in LMICs (female minus male)

(2) The gap between female life expectancy and male life expectancy does not have a statistically significant association with the GGI in LMICs (female minus male)

(3) The gap between female overall YLD and male overall YLD of age between 15-64 years (per person) does not have a statistically significant association with the GGI in LMICs (female minus male, divided into two age groups by cut-off of 49 years)

(4) The gap between female YLD of HIV/AIDS and male YLD of

HIV/AIDS for ages between 15-64 years (per person) does not have a statistically significant association with the GGI in LMICs (female minus male, divided into two age groups by cut-off of 49 years)

(5) The gap between female YLD of diabetes and male YLD of diabetes for ages between 15-64 years (per person) does not have a statistically significant association with the GGI in LMICs (female minus male, divided into two age groups by cut-off of 49 years)

Chapter 2. Methods

2.1 Study Design

In this study, a panel analysis was used to investigate both the cross-sectional and longitudinal association between gender equality and gender difference in adult mortality and morbidity in LMICs.

To assess gender inequality, the GGI produced by the World Economic Forum from 2006 to 2016 was used. The GGI examines the gap between men and women in four sub-indices (Economic Participation and Opportunity, Educational Attainment, Health and Survival and Political Empowerment) and 14 different indicators that compose them. The index focuses on measuring gaps rather than levels; it captures gaps in outcome variables rather than gaps in input variables; it ranks countries according to gender equality rather than women's empowerment (The Global Gender Gap Report, 2018). The highest possible score is 1 (equality) and the lowest possible score is 0 (inequality).

Adult mortality rate and life expectancy at birth was chosen among many related measures of mortality to conduct panel analysis. It was the purpose of this study to target adult mortality as other mortality rates such as maternal mortality rates, infant mortality rates, and under 5 years old mortality rates lacked enough sex-disaggregated data to perform panel analysis from 2006 to 2016. Life expectancy was used to compare the projection of the ideal outcome and the average of life expectancy in LMICs. According to concept of shortfall equality, a maximum value is needed to measure the

magnitude of the shortfall. Data of adult mortality show a probability of dying between 15 and 60 years per 1000 population.

YLD (Years Lost due to Disability) of disability-adjusted life-years (DALY) produced from the Institute for Health Metrics and Evaluation was used to measure overall burden of all causes, HIV/AIDS, and diabetes. The WHO(2014) states:

> "Sum of DALYs represent the burden of disease, and can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability. DALY can be calculated by adding YLL (Years of Life Lost) and YLD (Years Lost due to Disability)"

It should be noted that there is no ideal value of morbidity for each disease, since the magnitude and direction of gender difference depends on the kind of disease. Even if one specific disease is addressed, the magnitude and direction of gender gap in health vary greatly by age of patients, targeted region and culture, and etc. For instance, the female burden of HIV/AIDS exceeds that of males' in Sub-Saharan Africa, which is opposite to the phenomenon observed in rest of the world. All regions except Sub-Saharan Africa show a greater male burden of HIV/AIDS over the female burden of HIV/AIDS (Global Burden of Disease, 2017, Appendix 2). As for YLD of diabetes, it is known that the prevalence ratio of diabetes is female:male = 2:3 in Europe (Gale, 2001), but the ratio is not clear in LMICs.

Because overall YLD consists of YLD of diseases which show differences in prevalence and burden by gender, it can be agreed that

the trend of gender gap in morbidity cannot be generalized by one gross measure of overall YLD. Therefore, the YLD of HIV/AIDS and YLD of diabetes were examined in addition to overall YLD,

This study used World Bank Atlas method when grouping target countries. According to World Bank Atlas method, low-income economies are defined as those with a GNI per capita of $995 or less in 2017; lower middle-income economies are those with a GNI per capita between $996 and $3,895; upper middle-income economies are those with a GNI per capita between $3,896 and $12,055; high-income economies are those with a GNI per capita of $12,056 or more (World Bank, 2018). In this study, LICs, LMICs, and UMICs were categorized into two groups, lower income group that consists of LICs and LMICs, and a relatively higher income group, UMICs. Data of LICs and LMICs were merged in order to obtain a large enough sample to generate reliable results.

2.2 Measures and Data Sources

2.2.1 Dependent variable

Health outcomes can be roughly divided into those are related with mortality and those related with morbidity. This study used two dependent variables related with mortality (gender difference in adult mortality, gender difference in life expectancy), and three dependent variables related with morbidity (gender difference in overall YLD, gender difference in HIV/AIDS, gender difference in YLD of diabetes). And dependent variables regarding morbidity were again divided by two age groups of those aged 15-49 years and 50-64 years, resulting in eight dependent variables in total. The age 49 was used as a cut-off point because it is commonly chosen as a maximum age

for women of reproductive age. The Demographic and Health Surveys (DHS) also follow this standard. This study intended to examine adult morbidity with and without the possibility and burden of women giving birth. In addition, the age 64 was used as an upper bound of the older age group to exclude elderly (aged 65 or older) from the target population of this study.

Adult mortality data of both genders between 2006 and 2016 were collected from WHO, and overall adult morbidity data of both genders between 2006 and 2016 were collected from IHME, GBD Results Tool.

2.2.2 The GGI, the primary independent variable

There are several gender-related indices to identify and measure gender equality at the country level, such as the Gender Gap Index (GGI), the Gender Inequality Index (GII), the Gender Quality Index (GQI), the Social Institutions and Gender Index (SIGI), and the Glass Ceiling Index (GCI). Among these indices, the GGI and GII are measured annually; GQI is measured biannually; SIGI and GCI have been reported only once. GQI and GCI are measured in countries that are well-off, such as the European Union or OECD member countries.

There are previous studies that use GII to examine the association between gender inequality and health outcomes. According to the UN, the GII measures gender inequalities in reproductive health, empowerment, and economic status to better expose differences in the distribution of achievements between women and men (UNDP). But Permanyer (2013) notes that the GII does lead to conceptual and methodological problems since it mixes women-specific indicators

together with indicators that are computed for women and men. Anand (2018) also argues in detail that the GII is not appropriate for measuring gender inequality *and* health disadvantage (Anand, 2018).

It is also laden with technical problems which arise inter alia from its triple-level "general means of general means" approach to measurement (leading to a formula that certainly obscures understanding), and from the necessity to specify arbitrary non-zero numbers for the 'male' counterparts to MMR and AFR. The latter inevitably leads to non-monotonicity of the index with respect to increases in MMR and AFR. The property of GII that a worsening of women's reproductive health conditions, i.e. an increase in MMR and AFR from 0 upwards, first decreases and then increases GII must surely be regarded as anomalous - if not illogical.

Reference: Anand, 2018, Recasting Human Development Measures, p. 41, 42

The GGI is known to focus on "measuring gender-based gaps in access to resources and opportunities in countries rather than the actual levels of the available resources and opportunities in those countries" (World Economic Forum, 2015). The World Economic Forum intended to disassociate the GGI from countries' levels of development. For example, there may exist gender-related gaps within higher levels of health or education even in rich countries (World Economic Forum, 2018).

Of many indices, the GGI seems the most appropriate index to utilize in this study since it was developed to measure gender disparities and is measured yearly. The aim of the GGI is "to be a tool for

benchmarking and tracking global gender-based inequalities on economic, political, education- and health based criteria" (Hausmann et al. 2007, 3). The GGI consists of four dimensions: economic participation and opportunity, educational attainment, political empowerment and health and survival (Jager et al., 2009). Indicators used to calculate each dimension are shown in Table 1.

[Table 1] Description of the GGI

Subindex	Variable	Source
Economic Participation and Opportunity	Ratio: female labour force participation over male value	International Labour Organization, *ILOSTAT* database
	Wage equality between women and men for similar work (survey data, normalized on a 0-to-1 scale)	World Economic Forum, *Executive Opinion Survey (EOS)*
	Ratio: female estimated earned income over male value	World Economic Forum calculations based on the United Nations Development Programme methodology (refer to *Human Development Report 2007/2008*)
	Ratio: female legislators, senior officials and managers over male value	International Labour Organization, *ILOSTAT* database
	Ratio: female professional and technical workers over male value	International Labour Organization, *ILOSTAT* database

Educational Attainment	Ratio: female literacy rate over male value	United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics, *Education indicators,* database
	Ratio: female net primary enrolment rate over male value	UNESCO Institute for Statistics, *Education indicators* database
	Ratio: female net secondary enrolment rate over male value	UNESCO Institute for Statistics, *Education indicators* database
	Ratio: female gross tertiary enrolment ratio over male value	UNESCO Institute for Statistics, *Education indicators* database
Health and Survival	Sex ratio at birth (converted to female-over-male ratio)	United Nations Population Division, *World Population Prospects*
	Ratio: female healthy life expectancy over male value	World Health Organization, *Global Health Observatory* database
Political Empowerment	Ratio: females with seats in parliament over male value	Inter-Parliamentary Union, Women in Politics: 2016, reflecting elections/appointments up to 1 June 2016
	Ratio: females at ministerial level over male value	Inter-Parliamentary Union, Women in Politics: 2015, reflecting

		appointments up to 1 January 2015
	Ratio: number of years with a female head of state (last 50 years) over male value	World Economic Forum calculations, reflecting situation as of 30 June 2016

Source: The Global Gender Gap Report, 2016, World Economic Forum

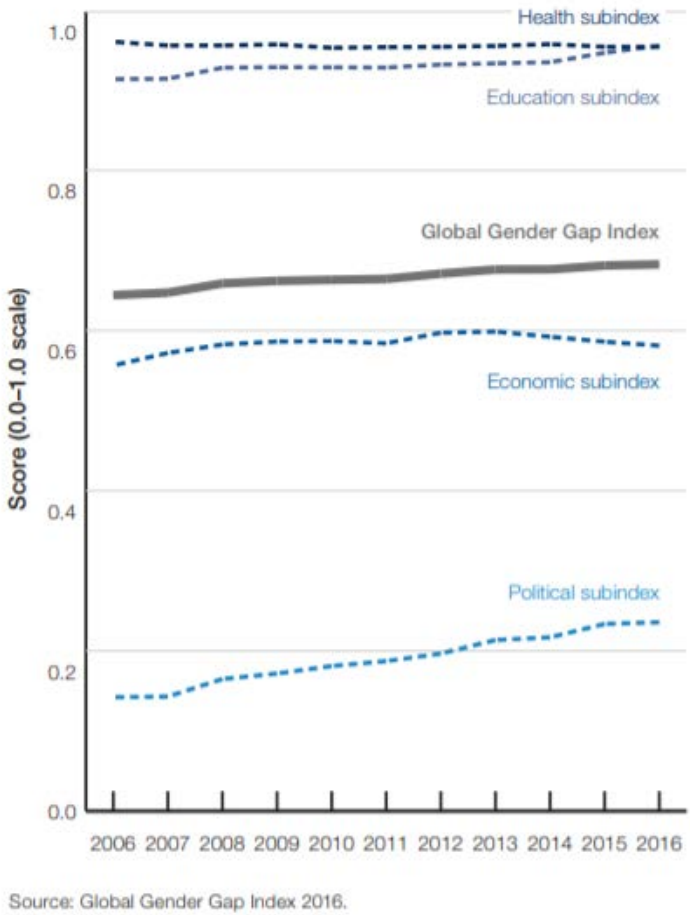
[Table 2] Calculation of weights within each subindex

Economic Participation and Opportunity Subindex			
Ratio	Standard deviation	Standard deviation per 1% point change	Weight
Female labour force participation over male value	0.160	0.063	0.199
Wage equality between women and men for similar work	0.103	0.097	0.310
Female estimated earned income over male value	0.144	0.069	0.221
Female legislators, senior officials and managers over male value	0.214	0.047	0.149
Female professional and technical workers over male value	0.262	0.038	0.121
Educational Attainment Subindex			
Ratio	Standard	Standard	Weight

	deviation	deviation per 1% point change	
Female literacy rate over male value	0.145	0.069	0.191
Female net primary enrolment rate over male value	0.060	0.167	0.459
Female net secondary enrolment rate over male value	0.120	0.083	0.230
Female gross tertiary enrolment ratio over male value	0.228	0.044	0.121
Health and Survival Subindex			
Ratio	Standard deviation	Standard deviation per 1% point change	Weight
Sex ratio at birth (converted to female-over-male ratio)	0.010	0.998	0.693
Female healthy life expectancy over male value	0.023	0.441	0.307
Political Empowerment Subindex			
Ratio	Standard deviation	Standard deviation per 1% point change	Weight
Females with seats in parliament over male value	0.166	0.060	0.310

Females at ministerial level over male value	0.208	0.048	0.247
Number of years with a female head of state (last 50 years) over male value	0.116	0.086	0.443

Time trend of the GGI and subindices between 2006 and 2016 is shown in figure below, indicating slight increase of the GGI score.



Source: Global Gender Gap Index 2016.

[Figure 2] Global Gender Gap Index and subindices evolution, 2006–2016.

There are GGI data available from 2006 for 97 LMIC countries, where

61 countries have complete GGI data available from 2006 to 2016.

2.2.3 Other Independent Variables

Other independent variables used in this study are GNI per capita, current health expenditure (herein CHE) per capita in PPP, female labor force as a percentage of the total labor force, primary completion rate, female (%), and access to anti-retroviral drugs, female (%). Each variable was examined to determine whether it has an impact on women's health (and in addition, gender gap in health). GNI per capita and CHE per capita in PPP were used to examine how economic status and governmental investment of developing countries influence gender differences in adult mortality and morbidity. Female labor force as a percentage of the total labor force, primary completion rate for females (%), and access to anti-retroviral drugs for females (%) were also used as independent variables since they reflect gender differences in education attainment, economic participation, and health care not captured by sub-indices of the GGI. Along with the GGI, these variables were also expected to be associated with the dependent variables.

Detailed description of variables and their sources are shown in Table 3.

[Table 3] Description of variables

Variable Type	Variable Name	Explanation	Source
Dependent variable	am_fm	Female adult mortality minus WHO male adult mortality per person	

		* mortality: probability of dying between 15 and 60 years per 1000 population	
Dependent variable	le_fm	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	World Bank
Dependent variable	allyld49fmpp	Female YLD of all diseases minus male YLD of all diseases (aged 15-49 years, per person)	IHME, GBD Results Tool
Dependent variable	allyld64fmpp	Female YLD of all diseases minus male YLD of all diseases (aged between 50-64 years, per person)	IHME, GBD Results Tool
Dependent variable	yldfm49_hiv	Female YLD of all diseases minus male YLD of all diseases (aged 15-49 years, per person)	IHME, GBD Results Tool
Dependent variable	yldfm64_hiv	Female YLD of HIV/AIDS minus male YLD of HIV/AIDS (aged 50-64 years, per person)	IHME, GBD Results Tool
Dependent variable	yldfm49_d	Female YLD of diabetes minus male YLD of diabetes (aged 15-49 years, per person)	IHME, GBD Results Tool
Dependent variable	yldfm64_d	Female YLD of diabetes minus male YLD of diabetes (aged 50-64 years, per person)	IHME, GBD Results Tool

Explanatory variable	GGI	The GGI	World Economic Forum
Control variable	GNI	GNI per capita	World Bank
Control variable	CHE	Current Health Expenditure (CHE) per Capita in PPP	World Bank
Control variable	Priedu_f	Female labor force as a percentage of the total show the extent to which women are active in the labor force. Labor force comprises people ages 15 and older who supply labor for the production of goods and services during a specified period	Derived using data from International Labour Organization, ILOSTAT database and World Bank population estimates.
Control variable	Labor_f	The number of new entrants (enrollments minus repeaters) in the last grade of primary education, regardless of age, divided by the population at the entrance age for the last grade of primary education	UNESCO Institute for Statistics (http://uis.unesco.org/)
Control variable	ARV_f	The percentage of adult females living with HIV who are receiving antiretroviral therapy (Access to anti-retroviral drugs of female, %)	UNAIDS estimates

2.3 Analysis

The multivariate regression analysis of panel data was conducted to investigate both the cross-sectional and longitudinal association between gender equality and gender difference in adult mortality and morbidity in LMICs. Dependent variables are presented as the difference score of females minus males. Statistical models to test previously mentioned hypotheses are shown below.

Model 1. $AM(f-m)_{it} = (\alpha_i + u_i) + \beta(GGI)_{it} + \gamma Z_{it} + \varepsilon_{it}$

Model 2. $LE(f-m)_{it} = (\alpha_i + u_i) + \beta(GGI)_{it} + \gamma Z_{it} + \varepsilon_{it}$

Model 3. $all\ YLD(f-m)_{it} = (\alpha_i + u_i) + \beta(GGI)_{it} + \gamma Z_{it} + \varepsilon_{it}$

Model 4. $YLD\ of\ HIV/AIDS\ (f-m)_{it} = (\alpha_i + u_i) + \beta(GGI)_{it} + \gamma Z_{it} + \varepsilon_{it}$

Model 5. $YLD\ of\ diabetes(f-m)_{it} = (\alpha_i + u_i) + \beta(GGI)_{it} + \gamma Z_{it} + \varepsilon_{it}$

where

$AM(f-m)_{it}$ = gender difference in adult mortality rate per person

$YLD(f-m)15_{it}$ = gender difference in overall YLD per person, aged $15-49$ years

i = countries, t = year α_i = unobserved heterogeneity,

u_i = idiosyncratic error term

β = regression coefficient of explanatory variables,

γ = regression coefficient of control variables, Z = control variables,

ε = error term

As mentioned earlier, for models 3, 4, and 5, which have YLD as the dependent variable, the target population is divided into two age groups, those aged 15-49 years and 50-64 years. Therefore, there are eight dependent variables in total for two target groups.

To decide which estimation technique to use, Breusch–Pagan Lagrange multiplier (LM) tests and Hausman tests were run. The null hypothesis in the LM test is that variances across entities are zero, which means that there is no significant panel effect. If the null hypothesis is rejected, a random effects model is selected. The pooled OLS regression is selected when the null hypothesis is not rejected.
To select the method of analysis, the LM test was performed on all cases available. The results of the LM test showed that the null hypothesis was rejected for all cases, therefore a random effects model was selected over pooled OLS regression.

The Hausman test was performed to determine whether a fixed effects model or a random effects model was appropriate. By using a fixed effects model, the effects of time–invariant characteristics of target countries on health outcomes are removed, thus only the effects of variables that vary over time on the health outcomes are assessed. On the other hand, random effects models can capture influences of country–specific characteristics on health outcomes. The Hausman test examines whether the value of estimates from both models have systematic differences. The null hypothesis is that the random effects model is preferred over a fixed effects model. If the test yields a test statistic value less than 0.01, then the null hypothesis is rejected at a significance level of 1% and a fixed random model is used.

STATA 14.2 was used to obtain descriptive statistics for 97 LMICs and to perform multiple regression analysis.

Chapter 3. Results

The association between GGI and gender differences in health outcomes between 2006 and 2016 was examined. There were 97 target countries in total: 11 low income countries (LICs), 22 lower-middle-income countries (LMICs), and 28 upper-middle-income countries (UMICs). LICs and LMICs were then combined to represent lower income countries, thus resulting in two country groups total. Data description of dependent variables and independent variables is shown below in Table 4.

[Table 4] Descriptive statistics

LICs and LMICs					
Variable	Obs	Mean	Std. Dev.	Min	Max
am_fm	616	−0.069	0.046	−0.251	0.011
le_fm	616	4.238	2.434	0.291	12.779
allyld49fmpp	616	0.093	0.047	−0.061	0.208
allyld64fmpp	616	0.0333	0.1118	−0.1300	0.6499
yldfm49_hiv	616	−0.72	0.076	−1.04	−0.608
yldfm64_hiv	616	0.0011	0.0034	−0.0114	0.0156
yldfm49_d	616	−0.004	0.005	−0.017	0.008
yldfm64_d	616	−0.0062	0.0069	−0.0229	0.0090
GGI	522	0.656	0.061	0.451	0.8
GNI	605	4030.463	2642.31	430	12010
CHE	596	210.518	154.796	30.643	806.344
Priedu_f	450	78.541	21.199	20.5	118.8
Labor_f	616	41.405	9.696	8.098	54.996
ARV_f	572	25.918	20.009	0	84

UMICs					
Variable	Obs	Mean	Std. Dev.	Min	Max
am_fm	451	−0.087	0.044	−0.27	−0.021
le_fm	451	5.722	2.08	2.054	12.91
allyld49fmpp	451	0.0820	0.0478	−0.0163	0.1693
allyld64fmpp	451	0.0078	0.0693	−0.2096	0.1699
yldfm49_hiv	451	−0.7	0.139	−1.459	−0.567
yldfm64_hiv	451	0.00004	0.0012	−0.0017	0.0071
yldfm49_d	451	−0.003	0.007	−0.025	0.015
yldfm64_d	451	−0.0041	0.0076	−0.0207	0.0138
GGI	404	0.676	0.04	0.577	0.771
GNI	438	12648.17	4436.65	4680	26900
CHE	428	816.014	387.783	181.072	3135.22
Priedu_f	315	97.529	8.834	69.6	126.3
Labor_f	451	39.17	8.29	14.909	50.845
ARV_f	352	32.778	20.447	0	95

[Table 5] Life expectancy by gender

	Female LE average	Male LE average	(Female−Male) average
LICs and LMICs	66.2	62.0	4.2
UMICs	75.6	69.9	5.7

Examining the mean value of adult mortality, it can be inferred that male mortality is higher than female mortality in general. As for LE, female LE exceeds male LE in both country groups included in the analysis (Table 5). According to WHO (2017), the standard life expectancy at birth is set at 91.94 for both women and men, but life expectancy of all countries is far behind this standard, especially in

LICs and LMICs. The gender gap in LE is 4.2 years in LICs and LMICs, and 5.7 years for UMICs, respectively (Table 5). In the perspective of shortfall equality, it can be inferred that LICs and LMICs are less gender equal than UMICs, since the gender gap of LE in LICs and LMICs is smaller than that of UMICs.

Examining the mean value of the gender gap in overall YLD, it can be inferred that the female disease burden of all causes generally overweighs male disease burden of all causes in all countries for all age groups. Except for adults aged 50 to 84 years in LICs and LMICs, male YLD of HIV/AIDS is higher than female YLD of HIV/AIDS in all countries and all age groups. Based on the mean value of YLD of diabetes, it can be inferred that male YLD of diabetes is higher than female YLD of diabetes.

Interestingly, mean of the GGI, the main independent variable, was only 0.0194699 higher in UMICs than in the lower income country group consisting of LICs and LMICs.

Since none of the variables were normal distributed, a Spearman's correlation coefficient was used to assess possible associations between variables. The Spearman's correlation coefficient matrix is presented in Table 6.

[Table 6] Correlation matrix

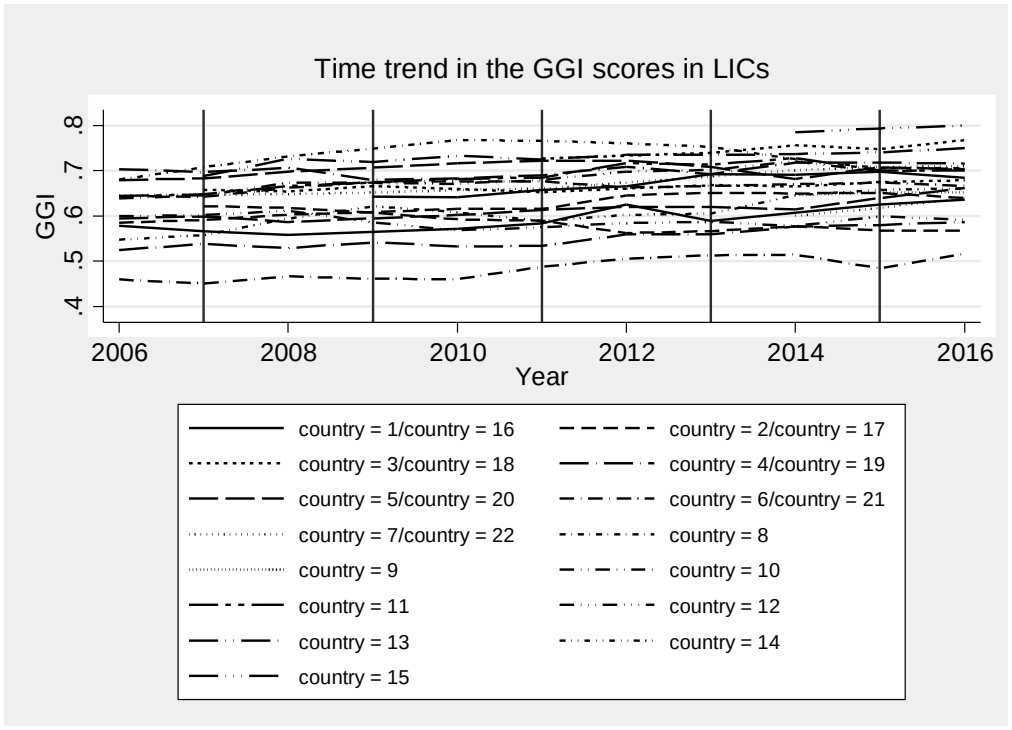
LICs and LMICs	GGI	GNI	CHE	Labor_f	Priedu_f	ARV_f
GGI	1.0000					
GNI	0.0699	1.0000				
CHE	0.1545	0.8513	1.0000			
Labor_f	0.3898	0.6056	0.6186	1.0000		
Priedu_f	0.3938	−0.4717	−0.2825	−0.1674	1.0000	
ARV_f	0.1832	−0.1149	0.0801	0.0424	0.2490	1.0000

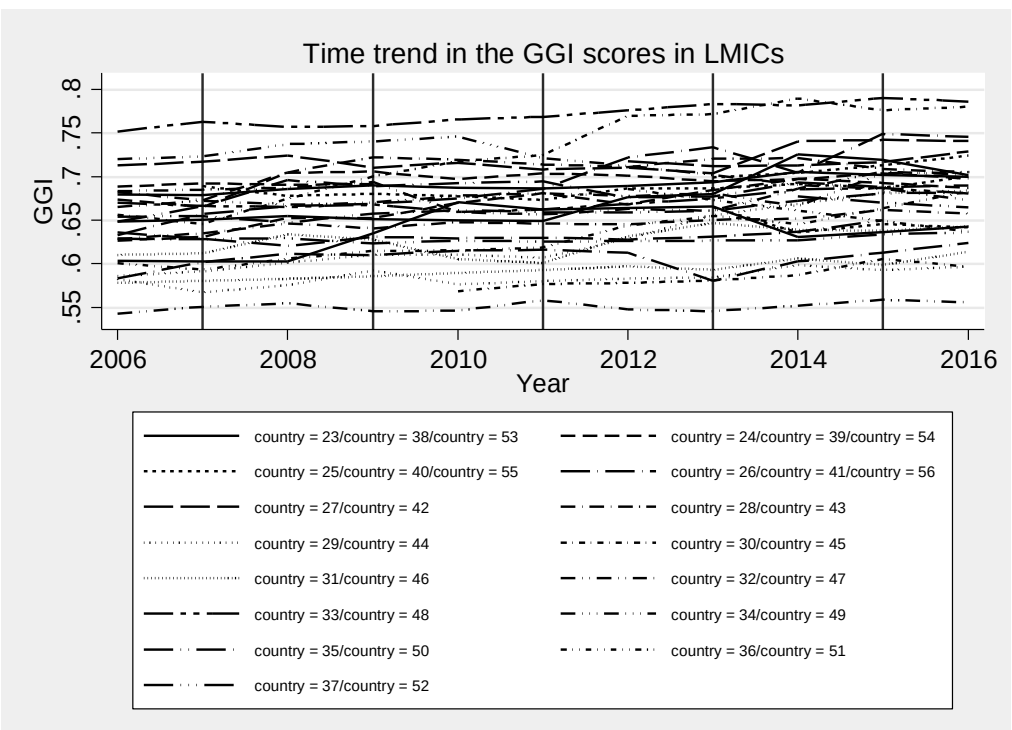
UMICs	GGI	GNI	CHE	Labor_f	Priedu_f	ARV_f
GGI	1.0000					
GNI	0.0317	1.0000				
CHE	0.1582	0.6441	1.0000			
Labor_f	0.3138	0.2061	0.0453	1.0000		
Priedu_f	0.7181	0.0091	−0.0389	0.1302	1.0000	
ARV_f	0.3218	0.2400	0.3400	−0.0482	0.1294	1.0000

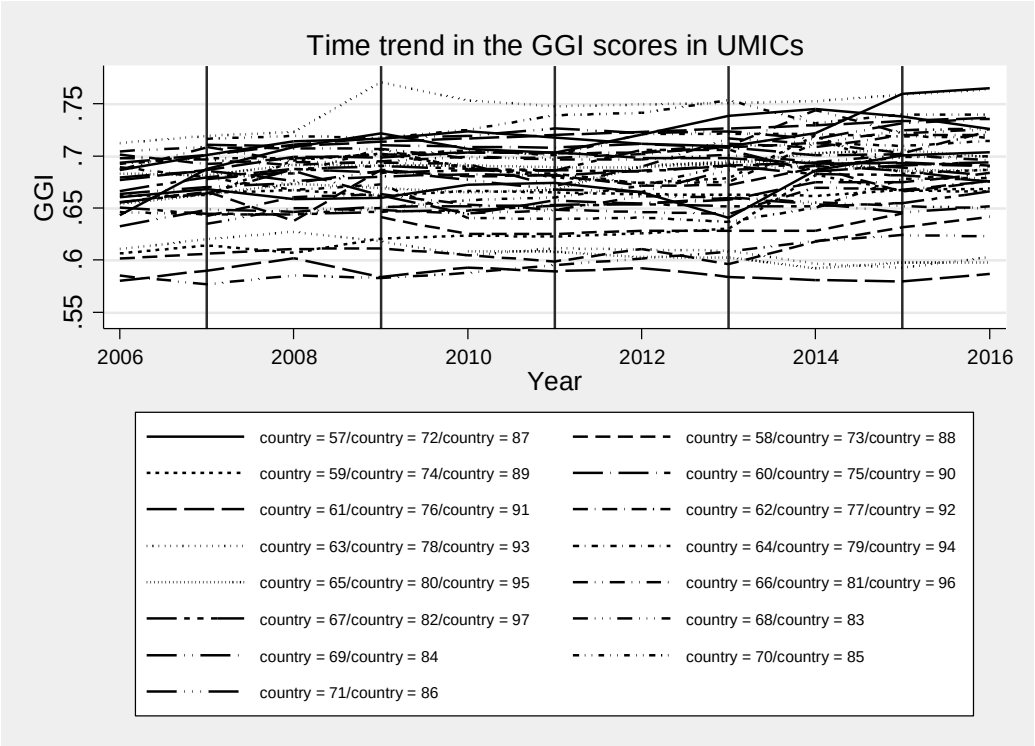
As for correlations between independent variables in LICs and LMICs, CHE had a high positive correlation with GNI per capita. Labor participation rate of females (%) had a moderate positive correlation with GNI per capita and CHE. GGI had a low positive correlation with labor force participation rate of females (%) and primary completion rate of females (%). Furthermore, a low negative correlation was found between GNI and primary completion rate of females (%). Negligible correlations were found in relationships between other independent variables.

As for correlations between independent variables in UMICs, the GGI had a high positive correlation with primary completion rate of females (%) and showed moderate positive correlations with labor force participation rate of females (%) as well as access to antiretroviral drugs of females (%). CHE had a moderate positive correlation with GNI per capita and had a low positive correlation with and access to antiretroviral drugs of females (%). Negligible correlations were found in relationships between other independent variables.

Time trends in the GGI scores in different income groups were then examined. No constant pattern in variation of the GGI emerged and the level of the GGI did not differ much by income level of the countries included in this study. This corresponds to the World Economic Forum's intention to disassociate the GGI from countries' levels of development (Figure 3).


Time trend in the GGI scores in LICs
GGI
.4
.5
.6
.7
.8
2006
2008
2010
2012
2014
2016
Year
country = 1/country = 16
country = 2/country = 17
country = 3/country = 18
country = 4/country = 19
country = 5/country = 20
country = 6/country = 21
country = 7/country = 22
country = 8
country = 9
country = 10
country = 11
country = 12
country = 13
country = 14
country = 15


Time trend in the GGI scores in LMICs
GGI
.55
.6
.65
.7
.75
.8
2006
2008
2010
2012
2014
2016
Year
country = 23/country = 38/country = 53
country = 24/country = 39/country = 54
country = 25/country = 40/country = 55
country = 26/country = 41/country = 56
country = 27/country = 42
country = 28/country = 43
country = 29/country = 44
country = 30/country = 45
country = 31/country = 46
country = 32/country = 47
country = 33/country = 48
country = 34/country = 49
country = 35/country = 50
country = 36/country = 51
country = 37/country = 52



[Figure 3] Time trend in the GGI scores by income groups, 2006−2016.

Time trends in the GGI scores in different income groups were examined. Again, no constant pattern in variation of the GGI emerged and the level of the GGI did not differ much by income level of the countries included in this study. This further corresponds World Economic Forum's intention to disassociate the GGI from countries' levels of development.

The results of panel analyses are presented in Table 7−12. Each table shows results of panel analyses that targeted the lower income group consisting of LICs and LMICs and the higher income group represented by UMICs, respectively. Fixed effects model or random effects models

are shown depending on the results of the Hausman test. Discussion and interpretation of the results are provided in next chapter.

The results of the panel analysis performed on gender differences in adult mortality (per person) in LICs and LMICs are shown in left column of Table 7. In LICs and LMICs, the GGI and access to antiretroviral drugs of females (%) showed a statistically significant negative association with gender differences in adult mortality (per person; $\alpha = .05$). When the GGI increases by 0.1, gender differences in adult mortality (per person) decrease by 0.014 (standard error = 0.0369, p−value < .0001). When access to antiretroviral drugs of females (%) increases by 1%, gender differences in adult mortality (per person) decrease by 0.0004 (standard error = 0.0001, p−value < .0001). The random effects model used in the analysis explained 5.34% of gender differences in adult mortality (per person). Also, gender differences in adult mortality (per person) significantly increased from 2006 to 2009 ($\alpha = .05$).

As for UMICs, labor participation of females (%) and access to antiretroviral drugs of females (%) were both significantly negatively associated with gender differences in adult mortality (per person), whereas primary completion rate of females (%) was significantly positively associated with the dependent variable ($\alpha = .05$).

[Table 7] Panel analysis of GGI and gender gap in adult mortality (per person) with control variables

	LICs and LMICs (RE)				UMICs (RE)			
	Coef.	Std. Err.	z	P >z	Coef.	Std. Err.	z	P >z
GGI	−0.1400	0.0369	−3.80	0.0000	0.0339	0.0614	0.55	0.5810
GNI	−0.0000	0.0000	−1.64	0.1010	0.0000	0.0000	0.97	0.3330
CHE	0.0000	0.0000	1.55	0.1220	0.0000	0.0000	0.05	0.9560
Pricom_f	0.0000	0.0001	0.40	0.6860	0.0003	0.0001	2.36	0.0180
Labor_f	−0.0004	0.0005	−0.77	0.4380	−0.0036	0.0006	−5.74	0.0000
Arvd_f	−0.0004	0.0001	−4.49	0.0000	−0.0002	0.0001	−2.23	0.0250
year								
2007	0.0031	0.0030	1.03	0.3010	−0.0014	0.0039	−0.35	0.7230
2008	0.0045	0.0030	1.48	0.1390	−0.0016	0.0041	−0.39	0.6970
2009	0.0078	0.0031	2.47	0.0140	0.0036	0.0043	0.83	0.4090
2010	0.0097	0.0035	2.78	0.0050	0.0037	0.0046	0.81	0.4180
2011	0.0122	0.0038	3.21	0.0010	0.0058	0.0050	1.17	0.2440
2012	0.0135	0.0041	3.28	0.0010	0.0092	0.0053	1.72	0.0850
2013	0.0130	0.0045	2.90	0.0040	0.0099	0.0060	1.66	0.0970
2014	0.0155	0.0050	3.10	0.0020	0.0136	0.0068	2.01	0.0450
2015	0.0190	0.0055	3.46	0.0010	0.0172	0.0070	2.44	0.0150
2016	0.0221	0.0061	3.59	0.0000	0.0200	0.0076	2.62	0.0090
sigma_u	0.0316				0.0340			
sigma_e	0.0101				0.0106			
Rho	0.9070				0.9114			
Number of obs	355				222			
Number of groups	49				28			
Prob>chi2	0.0004				0.0000			
R−sq								
Within	0.1288				0.3281			
Between	0.0365				0.2905			
Overall	0.0534				0.3074			

(Note. FE: fixed effects model, RE: random effects model)

A 1% increase in labor participation of females (%) and access to antiretroviral drugs of females (%) resulted in decreases in gender differences in adult mortality (per person) by 0.0036 (standard error = 0.0006, p−value = .0000), and 0.0002 (standard error = 0.0001, p−value = .0250), respectively.

On the other hand, a 1% increase in primary completion rate of females (%) resulted in an increase of 0.0003 (standard error = 0.0006, p−value = .0000). The random effects model used in the analysis explained 30.74% of gender differences in adult mortality (per person). Gender difference in adult mortality (per person) significantly increased from 2006 in the years 2014, 2015, and 2016 (α = .05), as well as 2012 and 2013 (α = 0.1).

Table 8 shows the results of the panel analysis performed on gender differences in life expectancy. In LICs and LMICs, CHE was significantly negatively associated with gender differences in life expectancy (α = .1).

On the other hand, the GGI and access to antiretroviral drugs of females (%) were significantly positively associated with the dependent variable (α = .05).

[Table 8] Panel analysis of GGI and gender gap in life expectancy with control variables

	LICs and LMICs (FE)				UMICs (RE)			
	Coef.	Std. Err.	t	P >t	Coef.	Std. Err.	z	P >z
GGI	4.4252	1.0481	4.22	0.0000	0.5809	2.0491	0.28	0.7770
GNI	0.0000	0.0000	0.63	0.5290	−0.0000	0.0000	−0.29	0.7710
CHE	−0.0027	0.0007	4.17	0.0000	0.0001	0.0003	0.22	0.8290
Pricom_f	−0.0046	0.0027	1.69	0.0910	−0.0088	0.0047	−1.86	0.0620
Labor_f	0.0025	0.0269	0.09	0.9250	0.1410	0.0233	6.04	0.0000
Arvd_f	0.0108	0.0028	3.91	0.0000	0.0039	0.0036	1.08	0.2810
year								
2007	−0.0014	0.0772	0.02	0.9850	0.1533	0.1273	1.20	0.2280
2008	−0.0783	0.0802	0.98	0.3290	0.0304	0.1355	0.22	0.8220
2009	−0.0773	0.0859	0.90	0.3690	−0.0250	0.1434	−0.17	0.8610
2010	−0.0716	0.0971	0.74	0.4620	−0.0443	0.1536	−0.29	0.7730
2011	−0.0470	0.1074	0.44	0.6620	−0.1176	0.1655	−0.71	0.4770
2012	−0.0241	0.1188	0.20	0.8390	−0.1664	0.1787	−0.93	0.3520
2013	0.0510	0.1313	0.39	0.6980	−0.1494	0.2007	−0.74	0.4570
2014	−0.0032	0.1500	0.02	0.9830	−0.2819	0.2272	−1.24	0.2150
2015	−0.0206	0.1662	0.12	0.9010	−0.3634	0.2367	−1.54	0.1250
2016	−0.0560	0.1853	0.30	0.7630	−0.4390	0.2567	−1.71	0.0870
sigma_u	2.5278				1.3414			
sigma_e	0.2819				0.3442			
Rho	0.9877				0.9382			
Number of obs	355				222			
Number of groups	49				28			
Prob>F/chi2	0.0000				0.0000			
R−sq								
Within	0.2624				0.1723			
Between	0.1304				0.4207			
Overall	0.1260				0.4484			

(Note. FE: fixed effects model, RE: random effects model)

When the CHE increases by one unit, gender differences in life expectancy decrease by 0.0027 (standard error = 0.0007, p−value = .0000). When the GGI increases by 0.1 and access to antiretroviral drugs of females (%) increases by 1%, gender differences in life expectancy increase by 0.44252 (standard error = 1.0481, p−value = .0000) and 0.0108 (standard error = 0.0028, p−value = .0000), respectively. The fixed effects model used in the analysis explained 26.24% of gender differences in life expectancy. Also, gender differences in life expectancy did not show a statistically significant change from 2006 to 2016 (α = .1).

As for UMICs, primary completion rate of females (%) was significantly negatively associated with gender differences in life expectancy (α = .1), whereas labor participation of females (%) was significantly positively associated with the dependent variable (α = .05). A 1% increase in primary completion rate of females (%) resulted in a decrease in gender differences in life expectancy by 0.0088 (standard error = 0.0047, p−value = .0620), whereas a 1% increase in labor participation of females (%) resulted in an increase in gender differences in life expectancy by 0.1410 (standard error = 0.0233, p−value = .0000).

The random effects model used in the analysis explained 44.84% of gender differences in life expectancy. Gender differences in life expectancy significantly increased compared from 2006 to 2016 (α = .1).

Table 9 shows the results of the panel analysis performed on gender differences in the overall YLD for the 15-49 age group (per person). In LICs and LMICs, GNI was significantly negatively associated with gender differences in overall YLD for those aged 15-49 years (per person). On the other hand, labor participation of females (%) and access to antiretroviral drugs of females (%) was significantly positively associated with the dependent variable (α = .05).

When GNI increases by one unit, gender differences in overall YLD for the 15-49 age group (per person) decreases by -0.000002 (standard error = 0.0000009, p-value = .0430). When the labor participation of females (%) and access to antiretroviral drugs of females (%) increase by 1%, gender differences in overall YLD for those aged 15-49 years (per person) increase by 0.0021 (standard error = 0.0006, p-value = .0000), and 0.0001 (standard error = 0.0001, p-value = .0330), respectively. The fixed effects model used in the analysis explained 18.40% of gender differences in overall YLD for those aged 15-49 years (per person). Also, gender differences in overall YLD for those aged 15-49

[Table 9] Panel analysis of GGI and gender gap in overall YLD of age 15-49 years (per person) with control variables

	LICs and LMICs (FE)				UMICs (RE)			
	Coef.	Std. Err.	t	P >t	Coef.	Std. Err.	z	P >z
GGI	0.0350	0.0219	1.60	0.1110	−0.0003	0.0177	−0.02	0.9860
GNI	−0.0000	0.0000	2.03	0.0430	0.0000	0.0000	0.14	0.8920
CHE	−0.0000	0.0000	1.52	0.1290	−0.0000	0.0000	−0.52	0.6020
Pricom_f	0.0000	0.0001	0.56	0.5730	−0.0000	0.0000	0.00	0.9970
Labor_f	0.0021	0.0006	3.72	0.0000	−0.0016	0.0003	−5.88	0.0000
Arvd_f	0.0001	0.0001	2.14	0.0330	0.0001	0.0000	3.19	0.0010
year								
2007	−0.0005	0.0016	0.32	0.7470	−0.0011	0.0011	−1.03	0.3040
2008	−0.0005	0.0017	0.28	0.7810	−0.0023	0.0011	−2.03	0.0430
2009	−0.0005	0.0018	0.26	0.7920	−0.0026	0.0012	−2.16	0.0310
2010	−0.0005	0.0020	0.15	0.8830	−0.0029	0.0013	−2.20	0.0280
2011	0.0003	0.0022	0.20	0.8430	−0.0027	0.0014	−1.90	0.0580
2012	0.0005	0.0025	0.20	0.8430	−0.0026	0.0015	−1.70	0.0890
2013	0.0005	0.0027	0.20	0.8410	−0.0035	0.0017	−2.04	0.0410
2014	0.0006	0.0031	0.01	0.9950	−0.0043	0.0020	−2.19	0.0290
2015	0.0000	0.0035	0.03	0.9800	−0.0039	0.0020	−1.91	0.0560
2016	0.0001	0.0039	0.40	0.6910	−0.0047	0.0022	−2.10	0.0360
sigma_u	0.0521				0.0441			
sigma_e	0.0059				0.0029			
Rho	0.9874				0.9956			
Number of obs	355				222			
Number of groups	49				28			
Prob>F/chi2	0.0000				0.0000			
R-sq								
Within	0.1840				0.2361			
Between	0.0554				0.1403			
Overall	0.0633				0.1543			

(Note. FE: fixed effects model, RE: random effects model)

years (per person) significantly increased from 2006 to 2010 and 2011 (α = .1).

As for UMICs, labor participation of females (%) was significantly negatively associated with gender difference in overall YLD for those aged 15-49 years (per person) (α = .1), whereas access to antiretroviral drugs of females (%) was significantly positively associated with the dependent variable (α = .05). A 1% increase in labor participation of females (%) resulted in a decrease in gender differences in overall YLD for those aged 15-49 years (per person) by 0.0016 (standard error = 0.0003 p-value = .0000), whereas a 1% increase in access to antiretroviral drugs of females (%) resulted in an increase in gender differences in overall YLD for those aged 15-49 years (per person) by 0.0001 (standard error = 0.0000, p-value = .0010).

The random effects model used in the analysis explained 15.43% of gender differences in overall YLD for those aged 15-49 years (per person). Gender differences in overall YLD for those aged 15-49 years (per person) significantly decreased from 2006 to 2008, 2009, 2010, 2013, 2014, and 2016 (α = .05), and significantly increased from 2006

to 2011, 2012, and 2015 (α = .1).

The results of the panel analysis of GGI and gender gap in overall YLD for the 50–64 age group (per person) are presented in Table 10. In LICs and LMICs, GNI (α = .05) and labor participation of females (%) (α = .1) was significantly negatively associated with gender differences in overall YLD for those aged age 50–64 years (per person). On the other hand, CHE and primary completion rate of females (%) was significantly positively associated with the dependent variable (α = .05).

When GNI increases by one unit and labor participation of females (%) increases by 1%, gender differences in overall YLD for those aged 50–64 years (per person) decrease by 0.000005 (standard error = 0.000001, p–value = .0000), and 0.0011 (standard error= 0.0006, p–value= .0840), respectively.

When CHE increases by one unit and primary completion rate of females (%) increases by 1%, gender differences in overall YLD for those aged 50–64 years (per person) increase by 0.0001 (standard error = 0.00002, p–value = .0000), and 0.0002 (standard error = 0.0001, p–value = .0100), respectively.

[Table 10] Panel analysis of GGI and gender gap in overall YLD of age 50-64 years (per person) with control variables

	LICs and LMICs (RE)				UMICs (RE)			
	Coef.	Std. Err.	z	P >z	Coef.	Std. Err.	Z	P >z
GGI	−0.0126	0.0277	−0.45	0.6510	0.0326	0.0332	0.98	0.3260
GNI	−0.0000	0.0000	−4.26	0.0000	0.0000	0.0000	1.78	0.0760
CHE	0.0001	0.0000	3.77	0.0000	0.0000	0.0000	5.11	0.0000
Pricom_f	0.0002	0.0001	2.57	0.0100	0.0002	0.0001	2.65	0.0080
Labor_f	−0.0011	0.0006	−1.73	0.0840	0.0015	0.0005	2.87	0.0040
Arvd_f	−0.0001	0.0001	−1.15	0.2500	−0.0002	0.0001	−3.05	0.0020
year								
2007	0.0014	0.0021	0.68	0.4960	−0.0035	0.0020	−1.77	0.0760
2008	0.0016	0.0021	0.75	0.4510	−0.0048	0.0021	−2.26	0.0240
2009	0.0008	0.0023	0.34	0.7330	−0.0070	0.0023	−3.12	0.0020
2010	0.0010	0.0026	0.40	0.6870	−0.0080	0.0024	−3.27	0.0010
2011	0.0008	0.0028	0.30	0.7660	−0.0094	0.0026	−3.56	0.0000
2012	0.0003	0.0031	0.11	0.9140	−0.0106	0.0029	−3.68	0.0000
2013	0.0002	0.0034	0.05	0.9640	−0.0101	0.0032	−3.11	0.0020
2014	−0.0010	0.0039	−0.25	0.8050	−0.0113	0.0037	−3.05	0.0020
2015	0.0002	0.0043	0.04	0.9680	−0.0129	0.0038	−3.36	0.0010
2016	0.0003	0.0048	0.07	0.9440	−0.0123	0.0042	−2.95	0.0030
sigma_u	0.0839				0.0738			
sigma_e	0.0076				0.0054			
Rho	0.9918				0.9946			
Number of obs	355				222			
Number of groups	49				28			
Prob>chi2	0.0000				0.0000			
R-sq								
Within	0.1428				0.2995			
Between	0.0002				0.0132			
Overall	0.0123				0.0015			

(Note. FE: fixed effects model, RE: random effects model)

The random effects model used in the analysis explained 1.23% of gender differences in overall YLD for those aged 50–64 years (per person). Also, gender differences in overall YLD for those aged 50–64 years (per person) did not show any statistically significant change compared to the year 2006.

As for UMICs, access to antiretroviral drugs of females (%) was significantly negatively associated with gender differences in overall YLD for those aged 50–64 years (per person), while GNI, CHE, labor participation of females (%), and primary completion rate of females (%) were significantly positively associated with the dependent variable (α = .05). A 1% increase in antiretroviral drugs of females (%) resulted in a decrease in gender difference in overall YLD for those aged 50–64 years (per person) by 0.0002 (standard error = 0.0001, p–value = .0020), whereas a 1% increase in GNI, CHE, labor participation of females (%), and primary completion rate of females (%) resulted in increases of 0.0000008 (standard error = 0.0000005, p–value = .07600), 0.00003 (standard error = 0.000005, p–value = .0000), 0.0015 (standard error = 0.0005, p–value= .0040), and 0.0002 (standard error = 0.0001, p–value = .0080), respectively.

The random effects model used in the analysis explained 0.15% of gender differences in overall YLD for those aged years (per person). Gender differences in overall YLD for those aged years (per person) showed a statistically significant increase from 2006 to 2007 (α = .1) and a statistically significant increase from 2006 to 2008 (α = .05).

The results of the panel analysis of GGI and gender gap in YLD of HIV/AIDS for the 15-49 age group (per person) are presented in Table 11. In LICs and LMICs, CHE was significantly negatively associated with gender differences in YLD of HIV/AIDS for those aged 15-49 years (per person). On the other hand, the GGI, primary completion rate of females (%), labor participation of females (%), and access to antiretroviral drugs of females (%) were significantly positively associated with the dependent variable (α = .05).

[Table 11]. Panel analysis of GGI and gender gap in YLD of HIV/AIDS of aged between 15–49 years (per person) with control variables

	LICs and LMICs (FE)				UMICs (FE)			
	Coef.	Std. Err.	t	P >t	Coef.	Std. Err.	t	P >t
GGI	0.0932	0.0291	3.20	0.0020	−0.0176	0.0198	−0.89	0.3760
GNI	−0.0000	0.0000	−1.51	0.1330	0.0000	0.0000	1.18	0.2390
CHE	−0.0001	0.0000	−5.41	0.0000	−0.0000	0.0000	−3.50	0.0010
Pricom_f	0.0002	0.0001	2.18	0.0300	0.0000	0.0000	0.33	0.7400
Labor_f	0.0037	0.0007	4.95	0.0000	−0.0019	0.0003	−5.82	0.0000
Arvd_f	0.0003	0.0001	4.37	0.0000	0.0001	0.0000	3.83	0.0000
year								
2007	0.0005	0.0021	0.24	0.8110	0.0005	0.0012	0.42	0.6740
2008	0.0029	0.0022	1.31	0.1920	−0.0002	0.0013	−0.17	0.8630
2009	0.0058	0.0024	2.41	0.0160	0.0003	0.0013	0.19	0.8460
2010	0.0069	0.0027	2.55	0.0110	0.0004	0.0015	0.28	0.7800
2011	0.0097	0.0030	3.26	0.0010	0.0010	0.0016	0.61	0.5420
2012	0.0107	0.0033	3.25	0.0010	0.0019	0.0017	1.10	0.2750
2013	0.0123	0.0036	3.38	0.0010	0.0015	0.0019	0.76	0.4470
2014	0.0130	0.0042	3.12	0.0020	0.0014	0.0022	0.63	0.5270
2015	0.0136	0.0046	2.95	0.0030	0.0028	0.0023	1.22	0.2240
2016	0.0154	0.0051	2.99	0.0030	0.0024	0.0025	0.95	0.3440
sigma_u	0.0830				0.0817			
sigma_e	0.0078				0.0033			
Rho	0.9912				0.9984			
Number of obs	355				222			
Number of groups	49				28			
Prob>F	0.0000				0.0000			
R−sq								
within	0.6017				0.2673			
between	0.0002				0.1126			
overall	0.0004				0.1372			

(Note. FE: fixed effects model, RE: random effects model)

When CHE increased by one unit, gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person) decreased by 0.0001 (standard error = 0.00001, p–value = .0000). When the GGI increased by 0.1 and primary completion rate of females (%), labor participation of females (%), access to antiretroviral drugs of females (%) increased by 1%, gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person) increased by 0.00932 (standard error = 0.0291, p–value = .0020), 0.0002 (standard error = 0.0001, p–value = .0300), 0.0037 (standard error = 0.0007, p–value = .0000), and 0.0003 (standard error = 0.0001, p–value = .0000), respectively.

The fixed effects model used in the analysis explained 60.17% of gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person). Also, there was a significant increase since year 2009 in gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person).

As for UMICs, CHE and labor participation of females (%) were significantly negatively associated with gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person), whereas access to antiretroviral drugs of females (%) was significantly positively associated with the dependent variable (α = .05). A one unit increase in CHE and a

1% increase in labor participation of females (%) resulted in decreases in gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person) by 0.00001 (standard error = 0.000003, p–value = .0010) and 0.0019 (standard error = 0.0003, p–value = .0000), respectively. And when access to antiretroviral drugs of females (%) increased by 1%, gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person) increased by 0.0001 (standard error = 0.00003, p–value = .0000).

The fixed effects model used in the analysis explained 26.73% of gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person). Gender differences in YLD of HIV/AIDS for those aged 15–49 years (per person) did not significantly change in YLD of HIV/AIDS from 2006 (α = .05).

The results of the panel analysis of GGI and gender gap in YLD of HIV/AIDS for the 50–64 age group (per person) are presented in Table 12.

In LICs and LMICs, CHE was significantly negatively associated with gender differences in YLD of HIV/AIDS for those aged 50–84 years

[Table 12] Panel analysis of GGI and gender gap in YLD of HIV/AIDS aged between 50−64 years (per person) with control variables

	LICs and LMICs (FE)				UMICs (FE)			
	Coef.	Std. Err.	z	P >z	Coef.	Std. Err.	z	P >z
GGI	0.0010	0.0026	0.37	0.7110	0.0043	0.0027	1.63	0.1050
GNI	−0.0000	0.0000	−0.86	0.3880	−0.0000	0.0000	−1.33	0.1850
CHE	−0.0000	0.0000	−2.03	0.0420	−0.0000	0.0000	−0.51	0.6090
Pricom_f	−0.0000	0.0000	−1.08	0.2810	0.0000	0.0000	2.48	0.0140
Labor_f	−0.0001	0.0000	−1.60	0.1090	−0.0001	0.0000	−1.30	0.1960
Arvd_f	0.0000	0.0000	2.12	0.0340	−0.0000	0.0000	−1.51	0.1320
year								
2007	−0.0001	0.0002	−0.32	0.7500	−0.0001	0.0002	−0.81	0.4170
2008	0.0001	0.0002	0.72	0.4690	−0.0001	0.0002	−0.68	0.4960
2009	0.0003	0.0002	1.27	0.2040	−0.0002	0.0002	−1.09	0.2750
2010	0.0004	0.0002	1.59	0.1120	−0.0001	0.0002	−0.39	0.7010
2011	0.0005	0.0003	1.84	0.0660	−0.0000	0.0002	−0.18	0.8560
2012	0.0005	0.0003	1.70	0.0890	−0.0001	0.0002	−0.29	0.7760
2013	0.0005	0.0003	1.66	0.0980	0.0000	0.0003	0.03	0.9770
2014	0.0005	0.0004	1.29	0.1970	0.0000	0.0003	0.03	0.9760
2015	0.0003	0.0004	0.85	0.3950	0.0001	0.0003	0.38	0.7060
2016	0.0003	0.0004	0.61	0.5430	0.0002	0.0003	0.49	0.6250
sigma_u	0.0038				0.0011			
sigma_e	0.0007				0.0004			
Rho	0.9641				0.8568			
Number of obs	355				222			
Number of groups	49				28			
Prob>F	0.0010				0.0291			
R−sq								
within	0.1215				0.1420			
between	0.0017				0.1723			
overall	0.0020				0.0936			

(Note. FE: fixed effects model, RE: random effects model)

(per person), whereas access to antiretroviral drugs of females (%) was significantly positively associated with the dependent variable (α = .05).

When CHE increased by one unit, gender differences in YLD of HIV/AIDS for the 50–64 age group (per person) decreased by 0.000003 (standard error = 0.000002, p–value = .0420). A 1% increase in access to antiretroviral drugs of females (%) resulted in gender differences in YLD of HIV/AIDS for those aged 50–64 years (per person) to increasing by 0.00001 (standard error = 0.000006, p–value = .0340).

The random effects model used in the analysis explained 4.20% of gender differences in YLD of HIV/AIDS for those aged 50–64 years (per person). Also, gender differences in YLD of HIV/AIDS significantly decreased in the years 2011, 2012, and 2013 (α = .1) compared to 2006.

As for UMICs, primary completion rate of females (%) was significantly positively associated with the dependent variable (α = .05). When the primary completion rate of females (%) increased by 1%, gender differences in YLD of HIV/AIDS for those aged 50–64 years (per person) increased by 0.00001 (standard error = 0.000005, p–value = .0140).

The fixed effects model used in the analysis explained 14.20% of gender differences in YLD of HIV/AIDS for those aged 50−64 years (per person). Gender differences in YLD of HIV/AIDS for those aged 50−64 years (per person) did not significantly change from the year 2006 (α = .05).

The results of the panel analysis of GGI and gender gap in YLD of diabetes for the 15−49 age group (per person) are presented in Table 13. In LICs and LMICs, CHE, labor participation of females (%) and access to antiretroviral drugs of females (%) were significantly negatively associated with gender differences in YLD of diabetes for those aged 15−49 years (per person), while access to primary completion rate of females (%) was significantly positively associated with the dependent variable (α = .05). Also GNI was significantly negatively associated with gender differences in YLD of diabetes for those aged 15−49 years (per person) at α = .1.

When GNI and CHE increased by one unit and labor participation of females (%) and access to antiretroviral drugs of females (%) increased by 1%, gender differences in YLD of diabetes for those aged 15−49 years (per person) decreased by 0.00000009 (standard error = 0.00000006,

[Table 13] Panel analysis of GGI and gender gap in YLD of diabetes aged between 15–49 years (per person) with control variables

	LICs and LMICs (RE)				UMICs (RE)			
	Coef.	Std. Err.	z	P >z	Coef.	Std. Err.	z	P >z
GGI	0.0013	0.0014	0.93	0.3510	−0.0094	0.0044	−2.15	0.0320
GNI	−0.0000	0.0000	−1.67	0.0960	0.0000	0.0000	0.12	0.9070
CHE	−0.0000	0.0000	−3.79	0.0000	0.0000	0.0000	1.07	0.2830
Pricom_f	0.0000	0.0000	2.39	0.0170	−0.0000	0.0000	−1.38	0.1670
Labor_f	−0.0001	0.0000	−2.29	0.0220	−0.0000	0.0001	−0.25	0.8030
Arvd_f	−0.0000	0.0000	−4.27	0.0000	0.0000	0.0000	1.90	0.0570
year								
2007	0.0001	0.0001	0.49	0.6250	0.0002	0.0003	0.71	0.4760
2008	0.0000	0.0001	0.20	0.8400	0.0003	0.0003	0.90	0.3700
2009	0.0000	0.0001	0.00	0.9980	0.0003	0.0003	1.08	0.2800
2010	0.0000	0.0001	0.07	0.9460	0.0002	0.0003	0.67	0.5000
2011	−0.0000	0.0001	−0.08	0.9350	0.0001	0.0004	0.37	0.7140
2012	0.0000	0.0002	0.19	0.8500	−0.0002	0.0004	−0.42	0.6780
2013	0.0001	0.0002	0.38	0.7050	−0.0004	0.0004	−0.96	0.3390
2014	0.0001	0.0002	0.55	0.5800	−0.0005	0.0005	−1.11	0.2680
2015	0.0002	0.0002	0.75	0.4540	−0.0008	0.0005	−1.65	0.1000
2016	0.0002	0.0002	1.03	0.3040	−0.0012	0.0006	−2.19	0.0280
sigma_u	0.0043				0.0042		−2.15	
sigma_e	0.0004				0.0007		0.12	
Rho	0.9928				0.9734		1.07	
Number of obs	355				222			
Number of groups	49				28			
Prob>chi2	0.0000				0.0000			
R−sq								
within	0.4101				0.2453			
between	0.0908				0.0164			
overall	0.0460				0.0077			

(Note. FE: fixed effects model, RE: random effects model)

p−value = .096), 0.000003 (standard error = 0.0000009, p−value = .0000), 0.00007 (standard error = 0.00003, p−value =.022), and 0.00002 (standard error = 0.000004, p−value = .0000), respectively. Additionally, when primary completion rate of females (%) increased by 1%, gender differences in YLD of diabetes for those aged 15−49 years (per person) increased by 0.000009 (standard error = 0.000004, p−value = .017).

The random effects model used in the analysis explained 4.60% of gender differences in YLD of diabetes for those aged 15−49 years (per person). Also, gender differences in YLD of diabetes for those aged 15−49 years (per person) did not significantly decrease compared 2006 (α = .05).

As for UMICs, the GGI was significantly negatively associated with gender differences in YLD of diabetes for those aged 15−49 years (per person) (α = .05), whereas access to antiretroviral drugs of females (%) was significantly positively associated with the dependent variable (α = .1). When the GGI increased by 0.1, gender differences in YLD of diabetes for those aged 15−49 years (per person) decreased by 0.00094 (standard error = 0.0044, p−value = .0320). And when access to antiretroviral drugs of females (%) increased by 1%, gender differences in YLD of

diabetes for those aged 15–49 years (per person) increased by 0.00001 (standard error = 0.000008, p–value = .057).

The random effects model used in the analysis explained 0.77% of gender differences in YLD of diabetes for those aged 15–49 years (per person). Gender difference in YLD of diabetes for those aged 15–49 years (per person) significantly increased in the year 2016 compared to the year 2006 (α = .05).

The results of the panel analysis of GGI and gender gap in YLD of diabetes for the 50–64 age group (per person) are presented in Table 14. In LICs and LMICs, CHE (α = .1) and access to antiretroviral drugs of females (%) (α = .05) were significantly negatively associated with gender differences in YLD of diabetes for those aged 50–64 years (per person), whereas GNI (α = .05), primary completion rate of females (%) (α = .05), and labor participation of females (%) (α = 0.1) were significantly positively associated with the dependent variable.

When GNI increased by one unit and primary completion rate of females (%) and labor participation of female (%) increased by 1%, gender

[Table 14] Panel analysis of GGI and gender gap in YLD of diabetes aged between 50-64 years (per person) with control variables

	LICs and LMICs (RE)				UMICs (RE)			
	Coef.	Std. Err.	z	P >z	Coef.	Std. Err.	t	P >t
GGI	0.0041	0.0026	1.59	0.1120	0.0100	0.0053	1.91	0.0560
GNI	0.0000	0.0000	4.02	0.0000	0.0000	0.0000	1.36	0.1730
CHE	−0.0000	0.0000	−1.69	0.0910	−0.0000	0.0000	−0.54	0.5910
Pricom_f	0.0000	0.0000	3.74	0.0000	−0.0000	0.0000	−0.54	0.5900
Labor_f	0.0001	0.0001	1.85	0.0640	0.0001	0.0001	1.04	0.2980
Arvd_f	−0.0000	0.0000	−3.05	0.0020	0.0000	0.0000	1.45	0.1470
year								
2007	0.0000	0.0002	0.17	0.8660	0.0001	0.0003	0.42	0.6720
2008	−0.0001	0.0002	−0.54	0.5890	−0.0001	0.0003	−0.18	0.8540
2009	−0.0002	0.0002	−1.04	0.2990	−0.0001	0.0004	−0.35	0.7290
2010	−0.0003	0.0002	−1.15	0.2500	−0.0001	0.0004	−0.26	0.7940
2011	−0.0003	0.0003	−1.12	0.2610	−0.0002	0.0004	−0.41	0.6790
2012	−0.0004	0.0003	−1.28	0.2020	−0.0004	0.0005	−0.79	0.4270
2013	−0.0003	0.0003	−1.01	0.3120	−0.0007	0.0005	−1.28	0.1990
2014	−0.0004	0.0004	−1.07	0.2870	−0.0010	0.0006	−1.68	0.0920
2015	−0.0004	0.0004	−1.03	0.3010	−0.0015	0.0006	−2.40	0.0170
2016	−0.0003	0.0004	−0.70	0.4850	−0.0016	0.0007	−2.42	0.0150
sigma_u	0.0068				0.0075			
sigma_e	0.0007				0.0009			
Rho	0.9895				0.9872			
Number of obs	355				222			
Number of groups	49				28			
Prob> chi2	0.0000				0.0191			
R-sq								
within	0.1774				0.1611			
between	0.0047				0.1151			
overall	0.0000				0.1443			

(Note. FE: fixed effects model, RE: random effects model)

differences in YLD of diabetes for those aged 50–64 years (per person) increased by 0.0000004 (standard error = 0.0000001, *p*–value = .0000), 0.00002 (standard error= 0.000007, *p*–value= .0000), and 0.0001 (standard error = 0.0001, *p*–value = .0640), respectively.

The random effects model used in the analysis explained 00.00% of gender differences in YLD of diabetes for those aged 50–64 years (per person). Gender differences in YLD of diabetes for those aged 50–64 years (per person) did not significantly change compared to the year 2006.

As for UMICs, the GGI was significantly positively associated with the dependent variable (α = .1). When the GGI increased by 0.1, gender differences in YLD of diabetes for those aged 50–64 years (per person) increased by 0.0100 (standard error = 0.0053, *p*–value = .0560).

The random effects model used in the analysis explained 14.43% of gender differences in YLD of diabetes for those aged 50–64 years (per person). Gender differences in YLD of diabetes for those aged 50–64 years (per person) significantly decreased in 2014 (α = .1), as well as in 2015 and 2016 (α = .05) compared to 2006.

Chapter 4. Discussion and Conclusion

The major objective of this study was to examine how gender equality is associated with gender gaps in adult mortality and morbidity in LMICs by investigating the association between the GGI and gender differences in adult mortality and morbidity from 2006 to 2016.

Reported results of the panel analyses were mixed and contradictory in some cases (Appendix 3). The five hypotheses listed in Chapter 1, p. xx, were tested by panel analyses. Ultimately, hypothesis 3 was not rejected and hypothesis 1, 2, 4, 5 were only partly rejected. That is, the gap between female adult mortality and male adult mortality (per person) shows a statistically significant negative association with the GGI in LICs and LMICs, but not with the GGI in UMICs; the gap between female life expectancy and male life expectancy shows a statistically significant positive association with the GGI in LICs and LMICs, but not with the GGI in UMICs; the gap between female overall YLD and male overall YLD for those between the ages of 50 and 64 years (per person) does not show any statistically significant association with the GGI in LICs and LMICs and UMICs; the gap between female YLD of HIV/AIDS and male YLD of HIV/AIDS for those between the ages of 15 and 49

years (per person) shows a statistically significant positive association with the GGI in LICs and LMICs; the gap between female YLD of diabetes and male YLD of diabetes for those between the ages of 15 and 49 years (per person) shows a statistically significant negative association with the GGI in UMICs; and the gap between female YLD of diabetes and male YLD of diabetes for those between the ages of 49 and 64 years (per person) shows a statistically significant positive association with the GGI in UMICs.

Concerning LICs and LMICs, these results show the importance of expanding the budget of CHE to combat HIV/AIDS and diabetes. It was found that CHE and the gender gap in YLD of HIV/AIDS for those aged 15–64 years was negatively associated; additionally, CHE and the gender gap in YLD of diabetes for those aged 15–64 years was negatively associated.

In UMICs, gender sensitive policies are needed to decrease the disease burden of diabetes. A 0.1 increase in the GGI results in a 0.00094 decrease in the gender gap of YLD of diabetes in population of those aged 15–49 years. That is, when a country becomes more gender equal, the gender gap in diabetes will likely decrease. Furthermore, it appears

beneficial for UMICs to increase the magnitude of CHE to decrease the burden of HIV/AIDS, since it was found that a one unit increase in CHE results in a decrease in the gender gap of YLD of HIV/AIDS in population of those aged 15–49 years by 0.000001. The GNI did not show any statistically significant associations with the gender gap in health in UMICs.

There are four main findings from this study. First, panel analyses revealed that the magnitude and direction of the gender gap in health vary greatly by context, which can differ greatly based on the type of disease, type of health outcome, income level of the country, age of patients, targeted region and culture, etc. Therefore, the results do not suggest one specific approach to the gender gap in adult morbidity is desirable. Different strategies are needed to close the overall gender gap in health, taking the complex nature of the specific gender gap into account.

Second, there appears to be no relationship between the signs of the coefficients of the GGI, GNI, and CHE in any way (Appendix 3). The fact that the GGI and GNI are not associated enables us to validate the main purpose of the GGI, which aims to merely measure the gender gap as

opposed to “the actual levels of the available resources and opportunities in those countries” (World Economic Forum, 2015), as aforementioned.

Third, every independent variable used in the analyses can have statistically significant negative associations and statistically significant positive associations with the gender gap in health (Appendix 3). That is, we cannot determine whether an independent variable will decrease the gender gap or increase the gender gap since it differs by the type of health outcome. These findings lead to the conclusion that understanding the gender context in each country is crucial and further research is needed to determine what causes different gender gap in health.

Lastly, regarding policy implication of this study, there is a need to pin down not only the gender gap, but also its direction. It is important to determine which gender suffers from more health disadvantages, as resources allocated for improving health are limited. Policy makers should devise action plans and policies that use existing resources strategically, or gender sensitively in this case. For example, for adults aged 15–49 years in LICs and LMICs and adults aged 15–64 years in UMICs, the female burden of HIV/AIDS is less than that of males'. Therefore, to decrease the disease burden of HIV/AIDS itself,

prevention and treatment of male HIV/AIDS patients in this age group should be reinforced. As for diabetes, the female disease burden is more than the male disease burden for all adults aged 15–64 years in all LMICs. To reduce the disease burden of diabetes overall, it would be effective to strengthen diabetes prevention programs that are targeting females.

One might wonder whether the gender gap in health can be closed or whether it should be closed. It is hard to say whether full gender equality will be achieved one day. As seen in the results of this study, male mortality far exceeds female mortality but female adult morbidity remains relatively higher than male adult morbidity. Closing the gender gap in health is inevitably related to women's empowerment to some degree, but it does not mean that only women's health should be improved. Hagedoorn (2001) states:

"Men's physical illness, for example, can impair the psychological health of their female partners; when men are sick, injured or die, households and female partners suffer a loss of income. Closing the men's health gap can benefit men, women and their children."

Therefore, the current results suggest that there is a need for gender mainstreaming in crafting global health policy and legislative work. According to European Institute for Gender Equality (EIGE; 2017):

"Gender mainstreaming involves the integration of a gender perspective into the preparation, design, implementation, monitoring and evaluation of policies, regulatory measures and spending programmes, with a view to promoting equality between women and men, and combating discrimination."

There are some limitations of the current study. Due to the absence of an accepted framework for the association between gender equality and the gender gap in health, the variables used in the present study were selected through trial and error. There may be more appropriate variables to reflect the multidimensional and dynamic nature of gender. Also, many variables other than the ones used in the current analyses were considered for inclusion, but lack of sufficient data did not allow those variables to be analyzed properly in this study. And out of a total of 1067 observations collected for this study, only 222 or 355 observations in total were used to perform each panel analysis. Lastly,

the GGI is an imperfect index for measuring gender equality, since it does not capture every aspect of this complex issue.

Despite of limitations mentioned above, this study provides longitudinal evidence for an association between gender equality and gender differences in adult mortality and morbidity in LMICs by analyzing country-level time-series data. This modeled the effects of the GGI and other factors on the gender gap in health over recent years. Future research should continue to measure the gender gap in health and capture the effects of gender equality on the gender gap in health outcomes by utilizing data that encompass biological, behavioral, and socioeconomic aspects of sex and gender. It is vital to promote gender awareness in the field of global health, educating future physicians and caregivers on gender equality.

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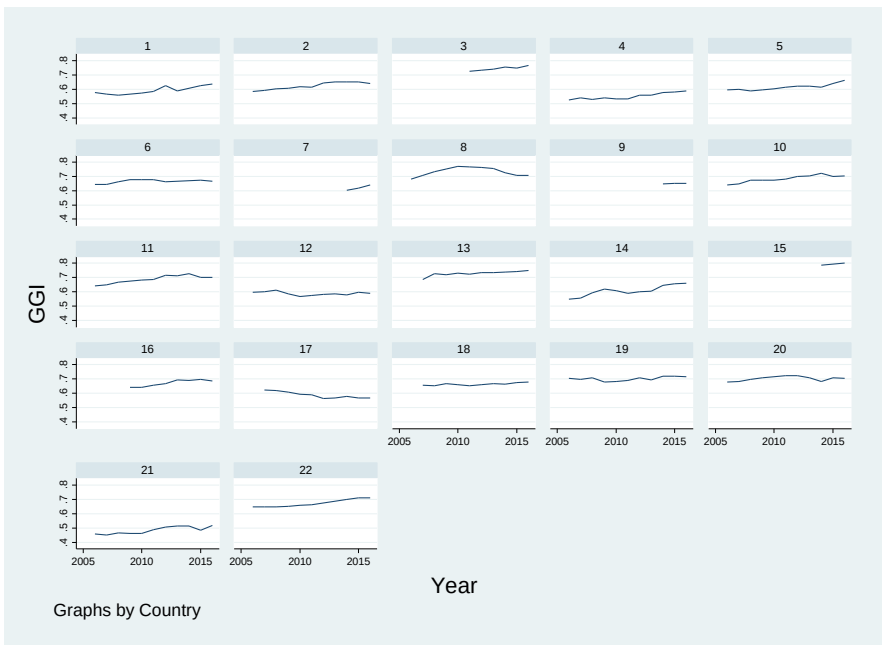
Appendix

1. Time trend in the GGI scores by income level

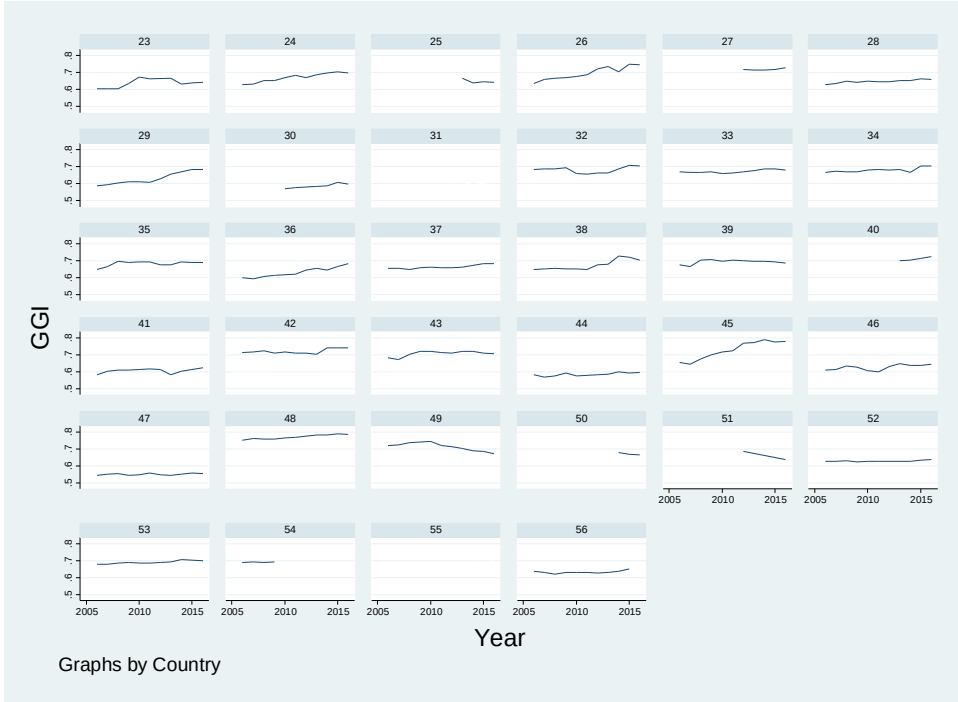
1.1 LICs

1	2	3	4	5	6
Benin	Burkina Faso	Burundi	Chad	Ethiopia	Gambia, The
7	8	9	10	11	12
Guinea	Lesotho	Liberia	Madagascar	Malawi	Mali
13	14	15	16	17	18
Mozambique	Nepal	Rwanda	Senegal	Syrian Arab Republic	Tajikistan
19	20	21	22		
Tanzania	Uganda	Yemen, Rep.	Zimbabwe		



1.2 LMICs

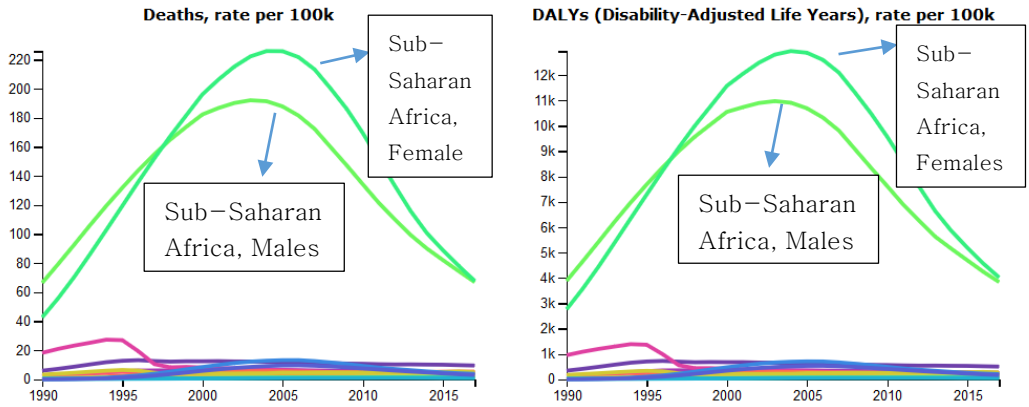
23	24	25	26	27	28
Angola	Bangladesh	Bhutan	Bolivia	Cabo Verde	Cambodia
29	30	31	32	33	34
Cameroon	Cote d'Ivoire	Egypt, Arab Rep.	El Salvador	Georgia	Ghana
35	36	37	38	39	40
Honduras	India	Indonesia	Kenya	Kyrgyz Republic	Lao PDR
41	42	43	44	45	46
Mauritania	Moldova	Mongolia	Morocco	Nicaragua	Nigeria
47	48	49	50	51	52
Pakistan	Philippines	Sri Lanka	Swaziland	Timor-Leste	Tunisia
53	54	55	56		
Ukraine	Uzbekistan	Vietnam	Zambia		



1.3 UMICs

57	58	59	60	61	62
Albania	Algeria	Armenia	Azerbaijan	Belarus	Belize
63	64	65	66	67	68
Bosnia and Herzegovina	Botswana	Brazil	Bulgaria	China	Colombia
69	70	71	72	73	74
Costa Rica	Cuba	Dominican Republic	Ecuador	Fiji	Guatemala
75	76	77	78	79	80
Guyana	Iran, Islamic Rep.	Jamaica	Jordan	Kazakhstan	Lebanon
81	82	83	84	85	86
Macedonia, FYR	Malaysia	Maldives	Mauritius	Mexico	Montenegro
87	88	89	90	91	92
Namibia	Paraguay	Peru	Romania	ssian Federat	Serbia
93	94	95	96	97	
South Africa	Suriname	Thailand	Turkey	Venezuela, RB	

2. Time trend of HIV/AIDS related deaths and DALYs, by World Bank region



Legend

- Latin America & Caribbean - WB, Males, All Ages, HIV/AIDS
- Latin America & Caribbean - WB, Females, All Ages, HIV/AIDS
- North America, Males, All Ages, HIV/AIDS
- North America, Females, All Ages, HIV/AIDS
- East Asia & Pacific - WB, Males, All Ages, HIV/AIDS
- East Asia & Pacific - WB, Females, All Ages, HIV/AIDS
- Europe & Central Asia - WB, Males, All Ages, HIV/AIDS
- Europe & Central Asia - WB, Females, All Ages, HIV/AIDS
- Sub-Saharan Africa - WB, Males, All Ages, HIV/AIDS
- Sub-Saharan Africa - WB, Females, All Ages, HIV/AIDS
- Middle East & North Africa - WB, Males, All Ages, HIV/AIDS
- Middle East & North Africa - WB, Females, All Ages, HIV/AIDS
- South Asia - WB, Males, All Ages, HIV/AIDS
- South Asia - WB, Females, All Ages, HIV/AIDS

3. Statistical significance of independent variables and signs of their coefficients in each analysis

3.1 Panel analysis of adult mortality

AM_(f−m)	Statistically significant when α =0.05		Statistically significant when α =0.1	
variable	LIC+LMIC RE	UMIC RE	LIC+LMIC	UMIC
GGI	✓, −	+		
GNI	−	+		
CHE	+	+		
Pricomp_f	+	✓, +		
Labor_f	−	✓, −		
Arvd_f	✓, −	✓, −		
LE_(f−m)	Statistically significant when α =0.05		Statistically significant when α =0.1	
variable	LIC+LMIC FE	UMIC RE	LIC+LMIC	UMIC
GGI	✓, +	+		
GNI	+	−		
CHE		+	✓, −	
Pricomp_f	−	−		✓, −
Labor_f	+	✓, +		
Arvd_f	✓, +	+		

(Note: ✓ when statistically significant, pp: per person)

3.2 Panel analysis of adult morbidity

Overall YLD 15−49 (f−m) pp	Statistically significant when α =0.05		Statistically significant when α =0.1	
variable	LIC+LMIC FE	UMIC RE	LIC+LMIC	UMIC
GGI	+	−		
GNI	✓, −	+		
CHE	−	−		
Pricomp_f	+	−		
Labor_f	✓, +	✓, −		
Arvd_f	✓, +	✓, +		
Overall YLD 50−64 (f−m) pp	Statistically significant when α =0.05		Statistically significant when α =0.1	
variable	LIC+LMIC RE	UMIC RE	LIC+LMIC	UMIC
GGI	−	+		
GNI	✓, −	+		
CHE	✓, +	✓, +		
Pricomp_f	✓, +	✓, +		
Labor_f		✓, +	✓, −	
Arvd_f	−	✓, −		

(Note: ✓ when statistically significant, pp: per person)

YLD of HIV 15-49 (f-m) pp	Statistically significant when α=0.05		Statistically significant when α =0.1	
variable	LIC+LMIC FE	UMIC FE	LIC+LMIC	UMIC
GGI	✓, +	−		
GNI	−	+		
CHE	✓, −	✓, −		
Pricomp_f	✓, +	+		
Labor_f	✓, +	✓, −		
Arvd_f	✓, +	✓, +		
YLD of HIV 50-64 (f-m) pp	Statistically significant when α=0.05		Statistically significant when α =0.1	
variable	LIC+LMIC FE	UMIC FE	LIC+LMIC	UMIC
GGI	+	+		
GNI	−	−		
CHE	✓, −	−		
Pricomp_f	−	✓, +		
Labor_f	−	−		
Arvd_f	✓, +	−		

(Note: ✓ when statistically significant, pp: per person)

YLD of DM 15-49 (f-m) pp	Statistically significant when α =0.05		Statistically significant when α =0.1	
variable	LIC+LMIC RE	UMIC RE	LIC+LMIC	UMIC
GGI	+	✓, −		
GNI		+	✓, −	
CHE	✓, −	+		
Pricomp_f	✓, +	−		
Labor_f	✓, −	−		
Arvd_f	✓, −			✓, +
YLD of DM 50-64 (f-m) pp	Statistically significant when α =0.05		Statistically significant when α =0.1	
variable	LIC+LMIC RE	UMIC FE	LIC+LMIC	UMIC
GGI	+	+		✓, +
GNI	✓, +	+		
CHE	−	−	✓, −	
Pricomp_f	✓, +	−		
Labor_f	+	+	✓, +	
Arvd_f	✓, −	+		

(Note: ✓ when statistically significant, pp: per person)

국문초록

개발도상국의 젠더 평등과 젠더 간 성인 사망 및 질병 차이의 관계: 패널 데이터 분석

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젠더 불평등은 국제적인 건강 격차에 기여하는 여러 요소 중 하나이다. 젠더 평등은 “한 사람의 생물학적 성에 기반한 기회, 자원의 분배 및 혜택, 혹은 서비스 접근에 대한 차별의 부재”로 정의된다 (WHO 젠더 정책, 2002). 젠더 불평등은 전세계적으로 여성의 건강과 남성의 건강 모두에 피해를 주며, 건강에서의 젠더 불평등을 해소하기 위해 효율적인 방안을 계획하려면 현재의 건강 결과의 젠더 격차가 분석되어야 한다. 현재까지 건강 결과의 젠더 격차에 어떤 요인들이 영향을 미치는지 고찰하는 연구는 많지 않았으며, 특히 중저소득국가 성인의 건강 결과의 젠더 격차와 젠더 평등의 관계에 대한 연구는 희박한 상황이다. 본 연구는 젠더 평등과 중저소득국가의 사망 및 질병 부담의 젠더 격차 사이에 어떤 연관성이 있는지 밝히고자 하였다.

연구 결과를 해석하는 데에는 Anand 와 Sen 이 1995 년 소개한 shortfall equality 와 attainment equality 의 개념을 고려하였다.

본 연구에서는 중저소득국가 성인의 사망 및 질병 부담의 젠더 격차와 젠더 평등의 연관성을 단면적으로, 종적으로 살펴보기 위해 패널 분석을 수행하였다. 각 국가가 젠더 불평등한 정도를 평가하기 위해 세계 경제 포럼에서 계산한 2006 년-2016 년의 GGI 값이 사용되었다. 성인 사망을 살펴보기 위한 여러 관련 지표들 중 성인 사망률과 기대 수명이 선택되었다. 모든 원인, HIV/AIDS, 당뇨로 인한 질병부담을 측정하기 위해 건강계측·평가연구소 (Institute for Health Metrics and Evaluation)에서 제공하는 장애로 인한 건강상실년수(years lost due to disability, YLD) 자료가 사용되었다. 본 연구의 대상인 중저소득국가들을 소득에 따라 저소득국가, 중저소득국가, 중고소득국가로 분류하는 데에는 세계 은행 아틀라스 도구(World Bank Atlas Method)를 사용하였다. 저소득국가와 중저소득국가의 데이터는 안정적인 분석 결과를 도출하기 위해 필요한 데이터 크기를 얻기 위해 병합되어 분석은 총 두 개 국가 집단에 대하여 이루어졌다.

성인 사망에 관한 분석 결과, 저소득국가와 중저소득국가에서 여성 성인 사망률과 남성 성인 사망률 사이의 격차와 GGI 가 통계적으로 유의한 음의

관계를 보이지만 중고소득국가에서는 그렇지 않았다. 저소득국가와 중저소득국가에서 여성 기대수명과 남성 기대수명의 격차는 GGI 와 통계적으로 유의한 양의 관계를 보였으나 중고소득국가에서는 그렇지 않았다. 성인의 질병 부담에 관한 분석 결과, 저소득국가, 중저소득국가, 중고소득국가 모두에서 15 세-64 세 여성의 모든 원인에 의한 YLD 와 15 세-64 세 남성의 모든 원인에 의한 YLD 사이의 격차는 GGI 와 통계적으로 유의한 관계를 보이지 않았다. 저소득국가와 중저소득국가에서 15 세-49 세 여성 HIV/AIDS 의 YLD 와 15 세-49 세 남성 HIV/AIDS 의 YLD 격차는 GGI 와 통계적으로 유의한 양의 관계를 보인다. 또한, 중고소득국가에서 15 세-49 세 여성 당뇨 YLD 와 15 세-49 세 남성 당뇨 YLD 의 격차는 GGI 와 통계적으로 유의한 음의 관계를 보이며, 50 세-64 세 여성 당뇨 YLD 와 50 세-64 세 남성 당뇨 YLD 의 격차는 GGI 와 통계적으로 유의한 양의 관계를 보인다.

저소득국가와 중저소득국가의 경우, 경상의료비와 15 세-64 세 성인 HIV/AIDS 의 YLD 의 젠더 격차 사이에 통계적으로 유의미한 음의 관계가 있는 것으로 나타났다. 또한, 경상의료비는 15 세-64 세 성인 당뇨의 YLD 젠더 격차와 통계적으로 유의미한 음의 관계를 보였다. 따라서 HIV/AIDS 및 당뇨의 질병 부담을 줄이기 위해 경상의료비에 할당된 예산을 확충하는 것이 중요할 것이라고 예상할 수 있다. 중고소득국가에서는 당뇨의 질병 부담을

감소시키기 위해 성인지적(gender sensitive) 정책이 필요하다고 결론지을 수 있다. 중고소득국가에서 GGI 가 0.1 만큼 증가했을 때 15 세-49 세 인구의 당뇨 YLD 의 젠더 격차를 0.00094 만큼 감소된다. 즉, 한 국가가 더 젠더 평등해질수록 당뇨 질병 부담의 젠더 격차는 더욱 감소한다는 것이다. 중고소득국가에서 HIV/AIDS 의 질병 부담을 감소시키기 위해 경상의료비를 증가시키는 것이 도움이 될 것으로 예상된다. 경상의료비가 한 단위 증가할 때 15 세-49 세 인구의 HIV/AIDS 의 YLD 의 젠더 격차는 0.000001 만큼 감소하기 때문이다. 한편, GNI 는 중고소득국가의 건강 결과의 젠더 격차와 통계적으로 유의한 관계를 보이지 않았다.

본 연구의 주된 결과는 다음과 같다. 첫째, 건강의 젠더 격차의 크기 및 방향은 맥락에 따라 크게 달라지며, 맥락은 질병의 종류, 건강 결과의 유형, 해당 국가의 소득 수준, 환자들의 나이, 대상 국가가 자리하는 지역 및 문화에 따라 크게 변화할 수 있다. 그러므로 본 연구는 성인 질병 부담의 젠더 격차의 하나의 특정한 방향이 바람직하다고 단정하지 않는다. 건강의 젠더 격차를 줄이기 위해서는 젠더 격차의 복잡한 속성을 고려한 여러 다른 전략들이 필요하다. 둘째, GGI, GNI, 경상의료비의 계수의 부호 사이에는 어떠한 관계도 존재하지 않는다. 셋째, 본 연구의 분석을 통해 사용된 모든 설명변수들이 건강의 젠더 격차와 통계적으로 유의한 양의 관계와 통계적으로 유의한 음의 관계 모두를 가질 수 있음을 알 수 있었다. 즉, 어떤

설명 변수가 젠더 격차를 감소시킬지 혹은 증가시킬지는 단정할 수 없다. 각 국가의 젠더 맥락이 어떠한지 이해할 필요하며, 무엇이 건강의 젠더 격차를 발생시키는지 살펴보는 후속 연구가 이루어져야 한다. 마지막으로, 보건 정책 수립에 있어서 젠더 격차 그 자체뿐 아니라 그 방향 또한 주목해야 한다. 건강 증진에 할당되는 자원은 한정되어 있기 때문에 어떤 젠더의 건강 불이익이 더 큰지 살펴볼 필요가 있다.

본 연구는 국제 보건 정책 수립 및 관련 법을 입법하는 데에 젠더 메인스트리밍이 필요하다고 제안한다.

Keyword: 젠더 평등, 젠더, 건강 결과의 젠더 격차, 젠더 메인스트리밍, 성인 사망, 성인 질병

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